BOONTON ELECTRONICS CORPORATION

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Instruction Manual

Model 92B

Millivoltmeter

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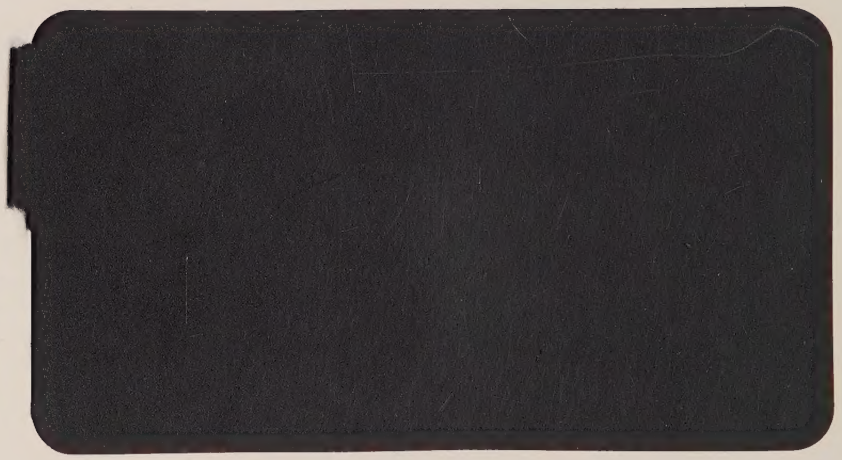
HIGH POWER TEST



Instruction Manual

Model 92B

Millivoltmeter

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92B
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BOONTON ELECTRONICS CORPORATION

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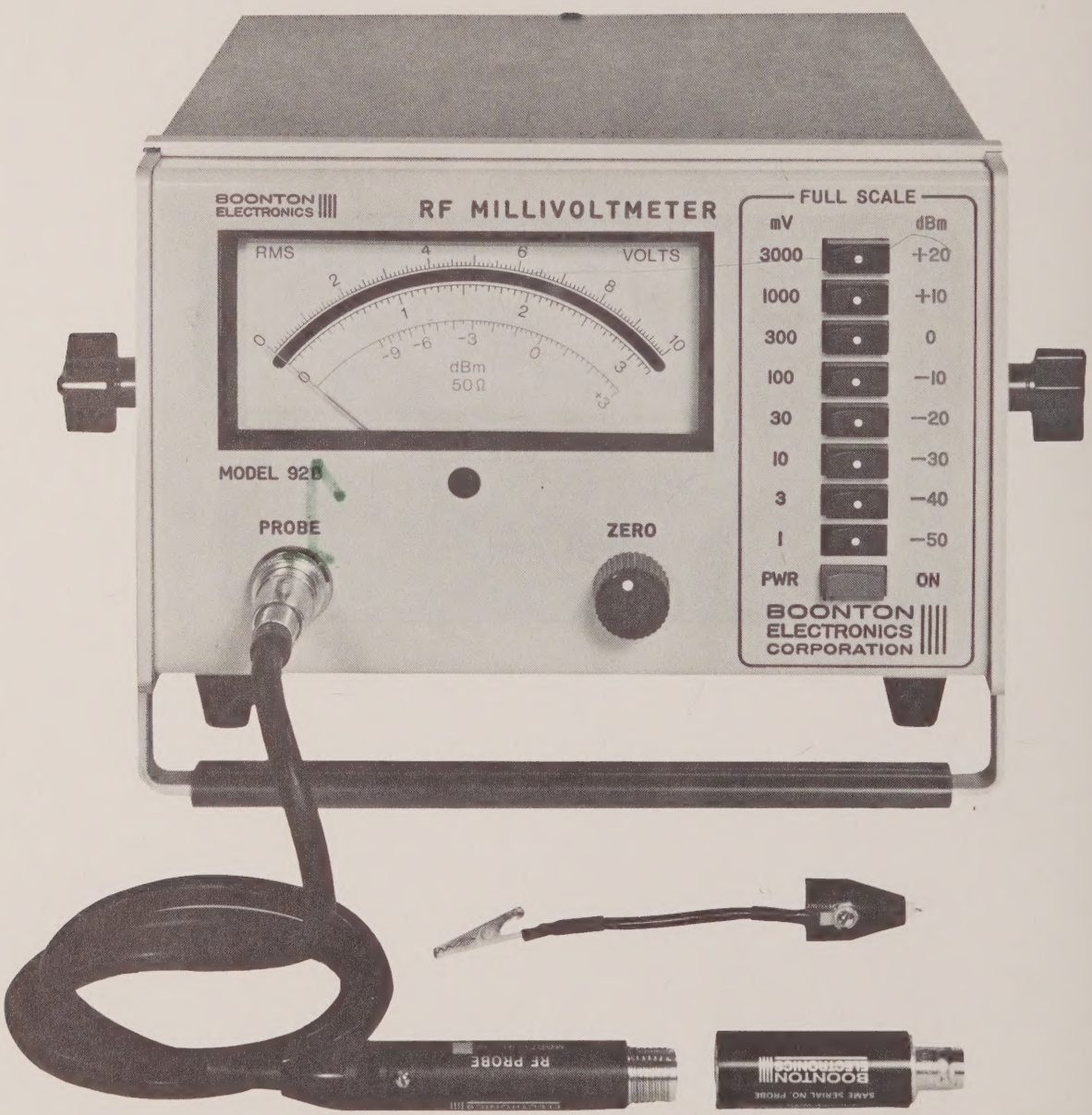

MODEL 92B RF MILLIVOLTMETER

ADDENDUM

ALL 91 AND 92 RF MILLIVOLTMETERS

SPECIFICATIONS:

Please add the specification for the 91-7C 100:1 Voltage Divider:

91-7C, 100:1 Voltage Divider, attenuates input signal by a factor of 100 (±1% plus ±1%/100 MHz).

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CHAPTER I

INTRODUCTION

1.1 GENERAL

The Model 92 Series RF Millivoltmeter provides an accurate readout of measurements from the low radio frequencies to the gigahertz region, over a voltage range of 200 μV to 3 volts. It is a programmable, solid-state instrument of high sensitivity and accuracy, characterized by high input impedance (see Figs 1 and 2), excellent stability, and low noise.

The Model 92 exhibits true rms response for input signals up to 30 millivolts, gradually approaching peak-to-peak above this level. The meter, however, is calibrated to indicate rms of a sine wave above 30mV.

Input and output connections for external control and readout are provided by a 22-pin card-edge connector at the rear of the instrument.

A linear dc output, whose level is proportional to the rf input voltage, is also provided at a rear connector. This may be used to drive a recorder, remote indicator or other analog devices.

The 92 offers a convenient and accurate means for making a wide variety of measurements. Typical uses of this instrument include:

In transistor testing the instrument may be used to measure β, f_t, and other transistor parameters.

VSWR and return loss measurement using the Model 92 Series with bridge methods, directional couplers, and adjustable or slotted lines.

Gain and loss measurements in wide-band amplifiers, including such design characteristics as stage gain, flatness of the pass band, upper cut-off or corner frequency, negative feedback factors, and other parameters.

Proper adjustment of tuned circuits in narrow-band amplifiers.

The adjustment, measurement of performance, and evaluation of rf filter parameters.

Measurement of vswr or return loss and attenuation of rf attenuators.

Measurement of output levels of signal generators, adjustment of baluns, harmonic distortion of rf signals, and adjustment of circuits for minimum voltage (null) or maximum voltage (peak).

The Model 92 is available in several optional configurations with a basic accuracy of 1% rdg. +1% fs. The standard features of the instrument are:

Remote programmability.

Measures from 200 μV to 3V* from 10 kHz to 1.2 GHz.

True rms response to 30 mV**

Convenient push-button ranging.

DC analog output.

High input resistance, low input capacitance.

Overload protection to 400 Vdc and 10 Vac.

VSWR less than 1.2 up to 1.2 GHz.

*To 300 V, up to 700 MHz, with accessory 100:1 divider.

**To 3V, up to 700 MHz, with accessory 100:1 divider.

The characteristics of the instrument include: high reliability, fast warm-up (1 minute typical), long intervals between calibrations, plug-in PC boards for ease in servicing or modifying, lightweight, and other advantages of solid state design.

1.2 EQUIPMENT DESCRIPTION

The Model 92 is basically a programmable analog instrument with linear dc output. It is available with a full range of options and accessories as described in Chapter II. Logic level programming, TTL/DTL compatible, is standard.

The instrument is sensitive, accurate, sturdily constructed, and protected against overloads. It will perform over extended periods of time without failure or need for recalibration. It is packaged as a compact bench instrument that can be easily mounted in a standard 19-inch rack using an optional rack-mounting kit.

Important input and accuracy specifications are reproduced on a reference plate fastened to the exterior top cover of the instrument. Clips for holding out-of-use accessories are provided at the rear of the instrument. Calibration instructions are reproduced on the underside of the top cover of the instrument.

Standard accessories supplied with the Model 92 Series include one each of the following:

Model 91-12F RF Probe with low-noise cable and connector.

Model 91-8B 50-ohm BNC adapter.

Model 91-13B Probe Tip (removable) with grounding clip lead.

A complete kit of probe accessories is available as optional equipment, including a storage case with space for the Model 91-12F RF Probe and the other standard accessories.

1.2.1 Frequency Capability

The calibrated frequency range of the Model 92 extends from 10 kHz to 1.2 GHz, with uncalibrated response to beyond 8 GHz. Relative accuracy above 1.2 GHz is typically ± 0.5 dB.

A Model 91-8B 50-ohm BNC Adapter is supplied as a standard accessory with the instrument for 50-ohm voltage measurements up to 600 MHz. A correction curve (Figure 7A) is included for frequencies above 50 MHz. For higher-frequency measurements and for through-line voltage measurements the optional accessory, Model 91-14A Tee Adapter, is recommended. It is designed to compensate for the rf probe capacitance and to present a good vswr (better than 1.15) up to 1.2 GHz. It may be used in conjunction with the Model 91-15A 50-ohm load for terminated voltage measurements. In a coaxial line its insertion loss is low; however, a chart (Figure 7B) is supplied showing loss vs. frequency. See Figure 4 for typical vswr.

An optional accessory, the Model 91-4C RF Probe, has a frequency range of 1 kHz to 250 MHz for lower frequency applications.

1.2.2 Voltage Capability

The Model 92 has eight ranges, from 1 millivolt full scale to 3 volts full scale, arranged in 1-3-10 sequence. No attenuator attachments are required for measurements up to 3 volts. While this range is ample for most rf voltage measurements, the capability of the instrument can be increased to 300 volts (up to 700 MHz) by using the optional accessory, Model 91-7C 100:1 Voltage Divider. Use of the 100:1 Voltage Divider also increases the input resistance of the Model 91-4C RF Probe by a factor greater than 100.

1.2.3 True RMS Response

The Model 92 provides true rms response for signal inputs below approximately 30 millivolts (below 3 volts, up to 700 MHz, with the Model 91-7C 100:1 Voltage Divider). As the input level increases, the waveform response gradually approaches peak-to-peak, calibrated on the indicator in rms. Thus, in addition to making precise sinusoidal voltage measurements at all levels, the instrument measures non-sinusoidal or asymmetrical signals within the rms region without loss of accuracy.

1.2.4 Low Noise

The Model 92 has been designed and constructed to hold noise from all sources to a minimum.

The probe cable is of special low-noise design; a vigorous flexing causes only momentary, minor deflections on the most sensitive range. The Model 91-12F Probe is not sensitive to shock or vibration; even sharp tapping on the probe barrel causes no visible deflection on any range.

Amplification takes place at 94 Hz, reducing susceptibility to any 50 or 60 Hz line-frequency-related fields. A unique circuit reduces the low-level noise originating from the mechanical chopper and renders the instrument immune to changes in chopper performance that could occur with the passage of time.

1.2.5 Minimal Zero Adjustment

Zero adjustment is not required on the upper five sensitivity ranges of the Model 92. For measurements on the lower three ranges, the ZERO control is set on the most sensitive range before operation. This control balances out small thermal voltages in the probe elements and, once adjusted, requires only infrequent checking during the course of subsequent measurements.

1.2.6 DC Output

The 92 provides a linear dc output whose current capability of 1 mA into 1000 ohms is extremely stable. When used as part of an automatic test system, the fast response of the instrument's dc output to an input step function allows more tests per unit time.

For system or external requirements, all input and output connections for the 92 are made at the card-edge connector on the rear of the instrument. (See Figure 11 for receptacle connections.)

CHAPTER II

SPECIFICATIONS

Voltage Range: 100 µV to 3V (300V up to 700 MHz with accessory 100:1 voltage divider). Voltage sensitivity is 100 µV.

Full Scale Voltage Range: 1, 3, 10, 30, 100, 300, 1000, and 3000 mV.

dBm Range: -60 to +23 dBm (+63 dBm up to 700 MHz with optional accessory, Model 91-7C 100:1 Voltage Divider).

Frequency Range: 10 kHz to 1.2 GHz (uncalibrated response to approximately 8 GHz).

Accuracy:

	1% fs plus			
300mV to 3V	1% rdg	1% rdg	3% rdg	10% rdg
100µV to 300mV*	2% rdg			7% rdg
	10 kHz	50 kHz	150 MHz	700 MHz	1.2 GHz

*Below 1 mV, add 1% fs

Meter: 4-1/2 inch taut-band
Two linear voltage scales
0 to 3; 0.05 per division
0 to 10; 0.1 per division
One logarithmic dBm scale
-10 to +3; 0.2 per division max.

Meter Unrest: (1 mV fs range only)

Indicated Voltage	Unrest
Above 600 μV	< 1% fs
300 μV to 600 μV	< 2% fs
100 μV to 300 μV	< 5% fs

Power: 115 or 230 V ±10%, 50 to 400 Hz.

RFI: There is no detectable radiated or conducted leakage from instrument or probe.

Temperature: In accordance with ANSI (ASA) Spec. 39.7.

Temperature Range	Temperature Instrument	Influence RF Probe
Ref. 21° to 25° C	0	0
Normal, 18° C to 30° C	0	±1% rdg
Severe, 10° C to 40° C	±1% rdg	±4% rdg

Waveform Response: True rms response for input levels up to 30 mV (3V to 700 MHz with 100:1 Voltage Divider), with transition to peak-to-peak (calibrated in rms) at higher levels.

Crest Factor: 420 to 1.4 depending upon input level (see Table II).

Input Impedance: See Figures 1 and 2.

VSWR: Less than 1.20 to 1.2 GHz (Return Loss greater than 23 dB). See Figures 3 and 4.

Power Sensitivity: 200 pW, minimum detectable power in 50 ohms.

DC Output: 0 to 10 V dc proportional to rf input voltage. Source resistance of 9 kΩ; will deliver 1 mA into 1 kΩ load. Full scale input step function response time less than 100 ms on 30 mV fs to 3V fs ranges, increasing to 1 sec. on the 1 mV fs range.

Dimensions: 5.2" H (without rubber feet), 8.3" W (1.2 of standard 19 inch rack module) 11.5" D (132 x 211 x 292 mm).

Weight: Net 7 lbs. (3.2 kg)

Accessories Furnished:

Model 91-12F, RF Probe. RF Probe with low-noise cable and connector assembly for measurements from 10 kHz to 1.2 GHz; see Figures 1 and 2 for input resistance and capacitance.

Model 91-13B, Probe Tip. Removable Probe Tip with grounding clip lead; for use up to approximately 100 MHz.

Model 91-8B, 50Ω BNC Adapter. Used for measurements up to 600 MHz with a 50-ohm system; for VSWR see curve of Figure 3.

Warm-Up: Warm-up period, typically 1 min. Adjust zero on 1 mV range when measuring below 30 mV.

Accessory Kit (Optional) Model 91-24A:

Model 91-6C, Unterminated BNC Adapter. Used for coaxial connection up to approximately 100 MHz, or to 400 MHz when fed from a 50-ohm source in an electrically short system.

Model 91-7C, 100:1 Voltage Divider. Attenuates input signal by a factor of 100 (±1%), permitting measurements up to 300 volts and extending the rms measuring range to 3 volts; increases input resistance by a factor of 1000; operates from 50 kHz to 700 MHz. Maximum input potential, 1000 volts, dc plus peak ac.

Model 91-14A, 50Ω Tee Adapter. Type N Tee Connector; with Model 91-15A termination (see below) permits connecting into 50-ohm line; required for measurements above approximately 100 MHz; for VSWR see curve of Figure 4.

Model 91-15A, 50Ω Termination. Type N 50-ohm termination for use with Model 91-14A Tee Connector.

Model 91-18A, Storage Case. Case for protecting and storing Model 92B accessories.

Other Accessories (Optional) Available:

Model 91-4C: Special 1 kHz to 250 MHz RF Probe. Low Frequency probe for measurements ranging from 1 kHz to 250 MHz; input resistance essentially the same as that of Model 91-12F, RF Probe.

Model 91-16A, Unterminated Type N Adapter. May be used with all probes, except Model 91-23A. Used for coaxial connection up to approximately 100 MHz, or to 400 MHz when fed from a 50-ohm source in an electrically short system.

Model 92-1A, Single Rack Mounting Kit. Kit for mounting one 92B as one-half of a module in a standard 19-inch rack.

Model 92-1B, Double Rack Mounting Kit. Kit for mounting two 92B's side-by-side in a standard 19-inch rack.

Standard Equipment Options:

Model 92B-03. dBV option, dB scale, referred to 1 volt.

Model 92B-04. dBV option, dB scale, referred to 1 volt, is read out on top scale on meter.

Model 92B-05. 75Ω dBm option; dBm scale, referred to 75Ω.

Model 92B-06. 75Ω dBm option; dBm scale, referred to 75Ω, read out on top scale on meter.

Model 92B-07. 50Ω dBm option; dBm scale, referred to 50Ω, read out on top scale on meter.

Model 92B-08. Rear signal-input option.

Model 92B-12. dBmV option, dB scale referred to 1 mV.

IMPORTANT NOTE:

Fully to exploit the capabilities of this instrument, the accessories listed below are required for the indicated ranges of operation.

Table 1. Required Accessories

MEASURING RANGE	REQUIRED ACCESSORY	REMARKS
100 MHz to 600 MHz	Model 91-8B 50Ω Adapter for shielded connection to 50-ohm line; other impedances available on request.	Supplied as standard equipment with the Model 92 Series
Above 600 MHz	Model 91-14A Tee Connector and 91-15A 50Ω Termination for connection into 50-ohm line.	Available separately
1 kHz to 250 kHz	Model 91-4C RF Probe	Available separately
Input levels up to 300 V; rms response with levels to 3V.	Model 91-7C 100:1 Voltage Divider; operates over frequency range from 50 kHz to 700 MHz	Available separately

For details on the availability of these and other Boonton Electronics Accessories for RF Voltmeters, call your local Boonton Electronics Sales Engineering Representative, or write directly to the factory at the address on the title page of this instruction book.

Table 2. Crest Factors

VOLTAGE RANGES (mV) AND CREST FACTORS								
VOLTAGE RANGES (mV)	1	3	10	30	100*	300*	1000*	3000*
CREST FACTOR**	420 to 42	70 to 14	21 to 4.2	7 to 1.4	420 to 42	70 to 14	21 to 4.2	7 to 1.4

*With accessory 100:1 Voltage Divider (see Table 1).
**Maximum permissible ratio of peak to rms value of voltage.

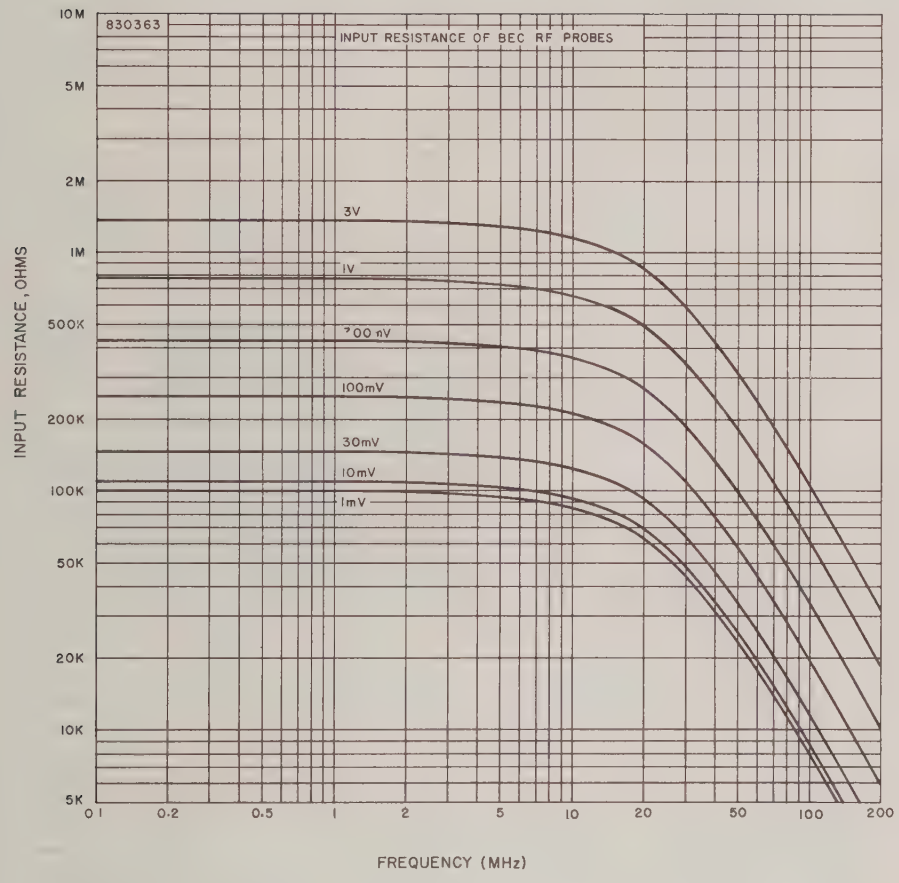


Figure 1. Input Resistance of RF Probe as a Function of Input Level and Frequency

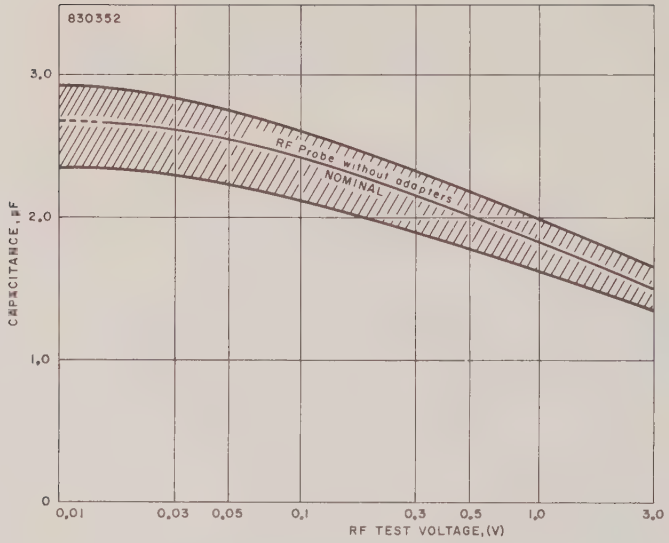


Figure 2. Input Capacitance vs Input Level of Model 91-12F Probe (Measured at 10MHz)

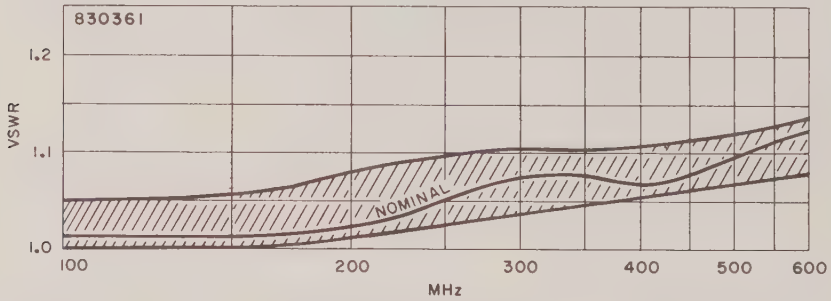


Figure 3. Typical VSWR of Model 91-12F RF Probe with Model 91-8B 50Ω BNC Adapter

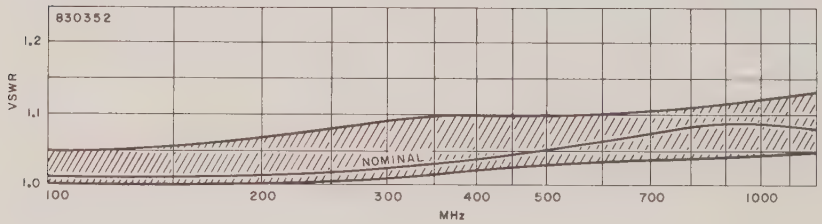


Figure 4.. Typical VSWR of Model 91-12F RF Probe with Model 91-14A Type N Tee Adapter and Model 91-15A 50Ω Termination

CHAPTER III

OPERATION

3.1 INSTALLATION

The Model 92B has been inspected and tested at the factory before packing, and is shipped ready for operation. If there is any indication of shipping damage, immediately notify the carrier before attempting to put the instrument into operation.

3.1.1 Operating Controls and Indicators

The controls and indicators installed on Model 92B are shown in Table 3.

Table 3. Model 92B Controls and Indicators

PWR ON	This switch turns on the instrument power.
FULL SCALE	These range pushbuttons, (1, 3, 10, 30, 100, 300, 1000, and 3000 mV) and (-50, -40, -30, -20, -10, 0, +10, and +20dB) select the operating range.
Meter	A 4-1/2 inch taut-band meter with two linear voltage scales reading out 0 to 3 with 0.05 per division and 0 - 10 with 0.1 per division; and one logarithmic dBm scale reading out -10 to +3 with 0.2 per division maximum.
PROBE (Jack)	The probe cable connects to the instrument through this PROBE jack. Always check that the knurled ferrule nut of the probe cable connection is tightened when in use.
ZERO (Control)	This control is used to zero the instrument.

The following items are on the rear panel:

Fuse Holder and Fuse	A fuse holder is located on the rear panel for installing either a 0.10 ampere, 115V, or a 0.06 ampere, 220 V, Bussman MDL SLO-BLO fuse.
Slide Switch	Switch which is set to 115 V or 230 V, according to the available power source. Be sure that the proper fuse is located in the fuse holder.
Recorder Output Terminals (Rear Panel)	A DC voltage proportional to the indicator reading is available at these terminals. F.S. output = +10V Output resistance = 9 kΩ
Component Holders (Clips)	Three component holders or component clips are located at the rear panel for securing accessories which are not in use.
REMOTE CONNECTIONS (Use with an Amphenol 225-22221-103 connector or equivalent)	A card edge connector is mounted at the rear of the instrument. See Figure 10 for the pin designations.
(Symbol on Rear Panel)	This safety requirement symbol has been adopted by the International Electrotechnical Commission, Document 66 (Central Office) 3, paragraph 5.3 which directs that an instrument be so labeled, if, for the correct use of the instrument, it is necessary to refer to the instruction manual. In this case it is recommended that reference be made to the instruction manual when connecting the instrument to the proper power source.

Verify that the right fuse is installed for the power available and that the switch on the rear panel 0.10A and 0.06A, 50-400Hz, is set to the applicable operating voltage of 115V or 230V. Within a brief time, the use of this symbol will be acted upon by ANSI (ASA).

3.2 OPERATING PROCEDURES

In the following paragraphs, the initial operating procedure for the 92B is described, as well as operating notes and recommended connection methods.

3.2.1 Initial Operating Procedure

a. Be sure that the serial number of the probe to be used is the same as that of the Model 92B. (Each instrument is calibrated for its particular rf probe.) Use of a probe other than that for which the instrument was calibrated may result in measurement errors.

b. Connect the probe cable to the PROBE jack on the front panel.

c. Check the setting of the power switch on the rear panel to be sure that it is set to the proper position for the line voltage available.

d. Plug the instrument's power cable into a power receptacle. Push PWR ON switch button.

e. Press the 1 mV range button; the panel meter pointer should rest on zero. If it does not, use the ZERO control to set the meter to zero. (This adjustment will hold for the other ranges.) The instrument is now ready for use. (See 3.3.5)

3.3 OPERATING NOTES

While using the Model 92B is a direct and straightforward process, there are certain precautions and procedures which MUST be observed to obtain satisfactory results.

3.3.1 Overload Limits

The Model 91-12F RF Probe supplied with the Model 92B is overload-protected to 10 volts, ac, and to 400 volts, dc. EXCEEDING THESE LIMITS MAY RESULT IN PERMANENT DAMAGE TO THE PROBE.

The Model 91-8B 50-ohm Adapter should not be subjected to continuous overload of more than 10 volts (dc + rms ac) to avoid excessive heating of the terminating resistor.

Where voltages above these limits are likely to be encountered, the Model 91-7C 100:1 Voltage Divider is required. Maximum rating of the Voltage Divider is 1000 volts, dc + peak ac.

3.3.2 Connection for Measurements Below 100 MHz

The RF Probe supplied with the Model 92B is equipped with a detachable tip and ground lead. For measurements of signals below approximately 100 MHz, this tip provides a convenient means for both signal and ground connection.

3.3.3 Connection for Measurements Above 100 MHz

For frequencies above 100 MHz, the probe tip should NOT be used with the Model 92B. Connection should be made directly to the center contact of the probe with the ground connection kept as short as possible

The connection recommendations outlined in Table 4 should be followed to maintain specified accuracy.

Table 4. Connection Recommendations

FREQUENCY	SIGNAL CONNECTION
Up to 100 MHz	Probe with tip and grounding lead, or with Model 91-8B (supplied) Probe with Model 91-14A/15A (optional)
100 to 250 MHz	Probe without tip (see Fig. 5), or probe with Model 91-8B (supplied) Probe with Model 91-14A/15A (optional)
250 to 600 MHz	Probe with Model 91-8B (supplied) Probe with Model 91-14A/15A (optional)
600 MHz to 1.2 GHz	Probe with Model 91-14A/15A (See Figure 5) (optional)

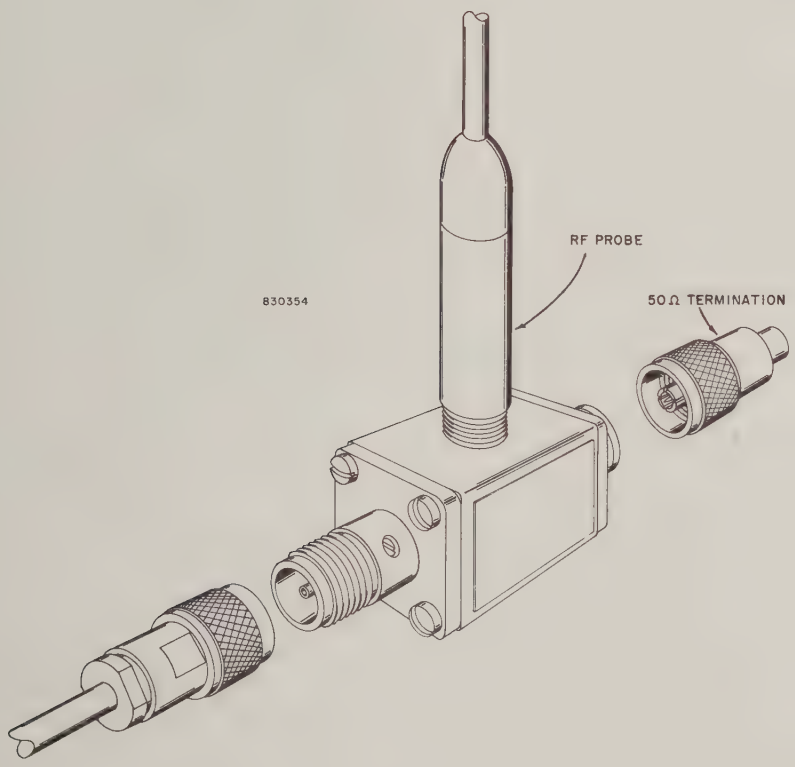


Figure 5. Assembly of Model 91-14A Type N Tee Adapter

3.3.4 Low-Level Measurement

The Model 92B will provide reliable, reproducible measurements of signal levels as low as 100 microvolts.

Preliminary zero adjustment is essential when using the lowest range scale to achieve the specified accuracy, and is strongly recommended for all ranges up to 30 millivolts.

3.3.5 Making the Zero Adjustment

When the instrument is to be used on the 1 mV range, the following zero adjustment procedure should be followed:

a. Set the FULL SCALE range selector to the 1 mV position.

b. Be sure that no voltage is applied to the probe, and that it is adequately shielded from local fields. This can be done by partially unscrewing the probe cap until the tip just breaks contact with the internal connector, leaving the metal shell engaged with the body threads. Alternately, the probe tip can be removed and the 50-ohm termination (Model 91-8B) mounted in its place.

c. Adjust the ZERO control to bring the meter reading to zero. Noise will cause the reading to fluctuate up to ± 5% of full scale. Adjust the ZERO control so that the reading averages zero.

3.3.6 Signal Overload on 1 mV Range

On the most sensitive (1 mV) range, application of a large ac signal overloads the amplifier and a short time is required for the high-impedance input circuit to discharge. This effect is significant for signals above approximately 100 millivolts. Typically, application of a 1 volt signal will require a recovery time of about thirty seconds before subsequent measurements should be made. It should be noted, however, that such overloads cause no damage to the equipment as long as they are within the limits outlined in paragraph 3.3.1.

3.3.7 Temperature Effects

The accuracy specifications for the Model 92B apply over temperatures from 50°F to 104°F. Outside of these limits operation of the equipment is possible but appreciable inaccuracies can be expected. However, no permament change in probe characteristics will result from any reasonable high or low temperature exposure.

It should be noted that inaccuracies of measurement resulting from temperature effects may occur shortly after soldering to the probe tip, or measuring with the probe in the vicinity of heat sources such as resistors, heat sinks, vacuum tubes, and so forth.

When making low-level measurements (below approximately 2 millivolts) it is important to make sure that the probe has attained a uniform temperature throughout its body. A temperature gradient between the inside and outside of the probe can generate a small thermal voltage that may add to the dc output of the detector diodes.

3.3.8 Hum, Noise, and Spurious Pick-up

When measuring low-level signals precautions should always be taken to avoid the possibility of errors of measurement resulting from hum, noise, or stray rf pick-up. Although all low-frequency hum and noise are attenuated at the input, it is still possible for unwanted high-level signals to cause errors. In some cases it may be necessary to provide extra shielding around the probe connections to reduce stray pick-up. Typical sources of spurious radiation are: induction or dielectric heating units, diathermy machines, local radio transmitters and grid dip meters.

3.4 DC OUTPUT

The dc output provided at the rear panel binding posts is a linear function (typically within 1%) of the input level, as long as the input signal is greater than 20% of full scale. For inputs less than 20% of full scale the output is NOT linear, but may be corrected by referring to paragraph 3.6 and Figure 6. Polarity of the dc output is positive with respect to the instrument ground, the nega-

tive dc output terminal being at ground potential. Output resistance is 9 kΩ.

3.5 LOW FREQUENCY MEASUREMENTS

The Model 91-12F RF Probe supplied with the Model 92B provides measurements within the specified accuracy from 10 kHz to 1.2 GHz. For measurements at lower frequencies the Model 91-4C RF Probe is available. It operates over a frequency range from 1 kHz to 250 MHz.

Important Note: After installing the Model 91-4C RF Probe, the Model 92B must be checked for accuracy of calibration, and recalibrated if required (see paragraphs 5.3 and 5.4).

3.6 CORRECTION CURVES FOR ACTUAL VOLTAGE vs METER READING

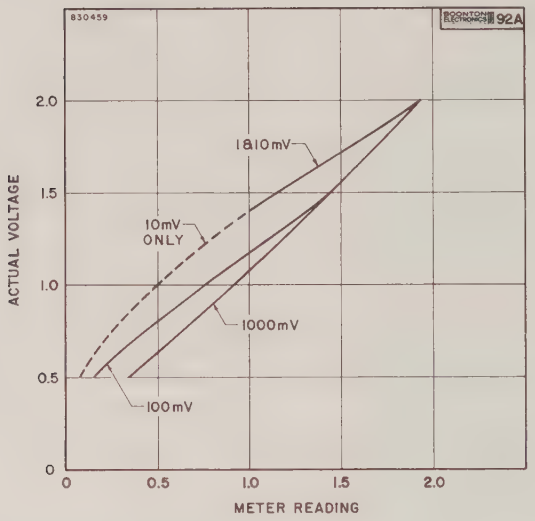
Use the curves of Figure 6 to correct for non-linearity below 20% of full scale on each range.

3.7 LOSS vs FREQUENCY CORRECTION FOR MODEL 91-8B

Use the curve of Figure 7a to make corrections for high-frequency roll-off when using the Model 91-8B 50Ω Adapter.

3.8 LOSS vs FREQUENCY CORRECTION CURVE FOR MODEL 91-14A

Use the curve of Figure 7b to make corrections for transmission loss when using the Model 91-14A Type N Tee Adapter.



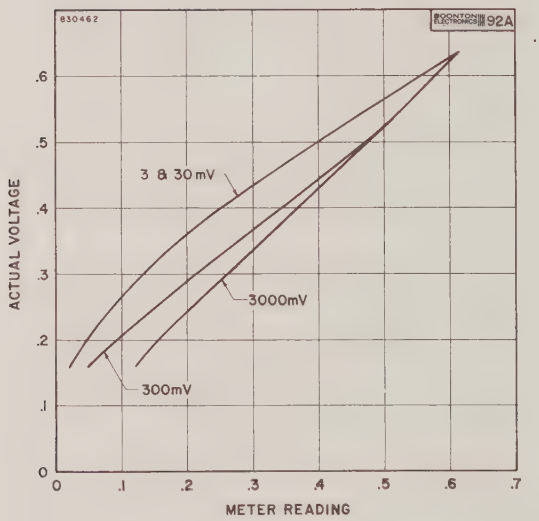
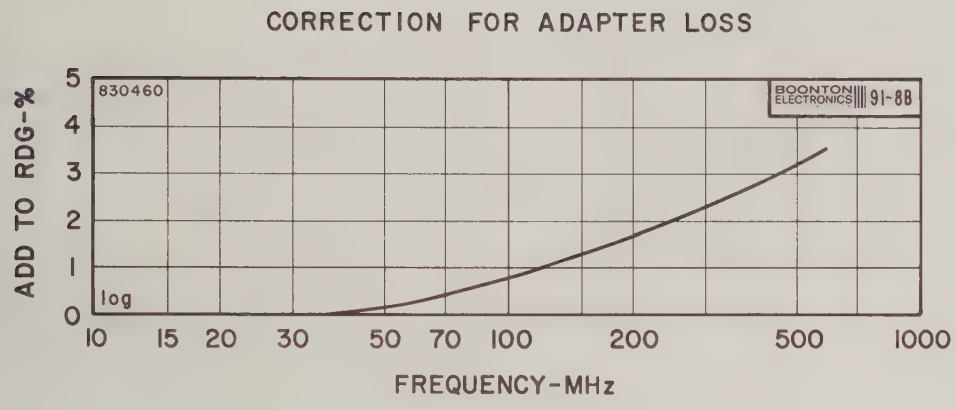


Figure 6. Correction Curves, Actual Voltage vs Meter Reading



EXAMPLE:
AT 250MHz, METER READS 50mV.
ADD 2%. TRUE VOLTAGE IS 51mV.

Figure 7A. Model 91-8B 50Ω BNC Adapter Correction Curve

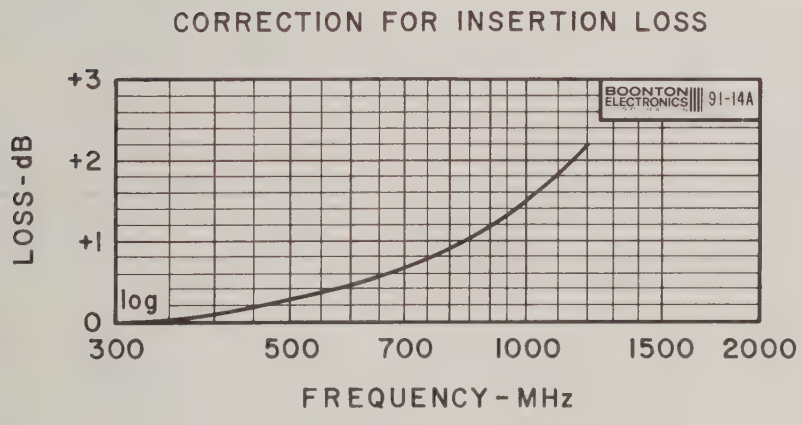


Figure 7B. Model 91-14A Type N Tee Adapter Correction Curve

CHAPTER IV

THEORY OF OPERATION

4.1 GENERAL

The operating principles of the Model 92B are shown in the following block diagram (Figure 8). The essential elements of the instrument are the probe, chopper driver, chopper, attenuator, preamplifier, amplifier, pulse generator, sync detector, shaping amplifier, panel meter and power supply.

4.1.1 RF Probe

The RF Probe embodies a full-wave diode detector which rectifies the signal under study to a dc voltage whose level is a function of the input level. While operating in the square-law region (below approximately 30 millivolts) the detector provides true rms response. As the input level increases beyond 30 millivolts, waveform response gradually approaches peak-to-peak, calibrated on the scale in rms.

In addition to increasing efficiency, use of full-wave rectification in the detector probe permits measurement of signals having highly asymmetrical waveforms without errors stemming from turn-over effect.

The diodes used in the RF Probe have been carefully selected for specific characteristics. The user is urged NOT to attempt their replacement with any off-the-shelf types. In case of damage to probe components, call your local Boonton Electronics Sales Engineering Representative or the factory for instructions.

4.1.2 Attenuator and Amplifiers

The dc output of the probe is converted to ac by the mechanical chopper. The resultant ac signal is applied to the attenuator and amplifier sections. For each range the output voltage from the 2nd amplifier is approximately 3V peak-to-peak. It is accomplished by ranging both the attenuation and the gain of the 2nd amplifier in the following manner:

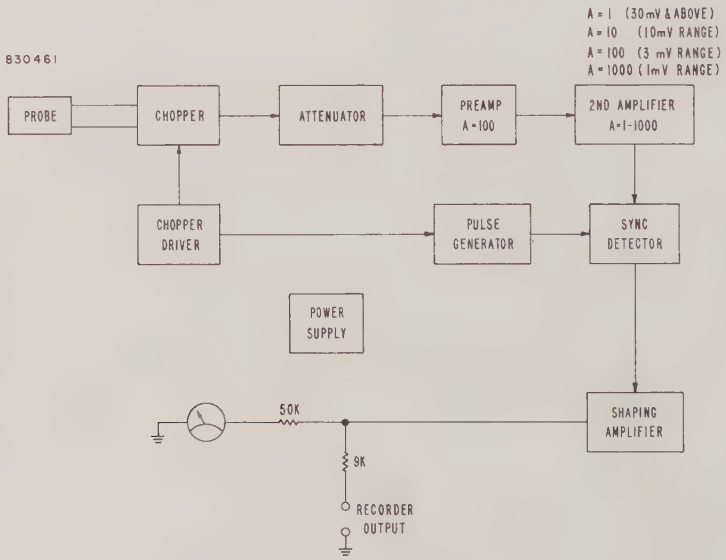


Figure 8. Block Diagram

RANGE	$\frac{1}{ATTN}$	GAIN 2nd AMP
1	1	1000
3	1	100
10	1	10
30	1	1
100	0.15	1
300	0.04	1
1000	0.01	1
3000	0.004	1

The preamplifier has a constant gain of X100, and is designed for very low input noise. Both amplifiers have moderately wide bandwidths and are stabilized by large amounts of negative feedback.

4.1.3 Synchronous Detector

The amplified ac signal from the 2nd amplifier is converted to dc by the synchronous detector. The peak-to-peak amplitude is derived from a shunt-series capacitor storage circuit using JFET switches. The synchronous detector is driven by pulses in the chopper-driver circuit, thus assuring exact synchronization. The characteristics of the detector determine the effective bandwidth of the amplifier-detector combination and allow modification of the bandwidth for different range conditions. The detector also provides conversion without offset, with excellent linearity.

4.1.4 Shaping Amplifier

The conversion of rf to dc in the probe is non-linear, the response being virtually square-law for the lowest ranges and gradually becoming quasi-linear for the 3V range. The shaping amplifier converts the non-linear output of the phase detector to a linear output by using a segmental approximation to the exact correction. The shaping amplifier is actually an operational amplifier so connected that, as the signal increases at its output, its gain is reduced by successively paralleling resistors across the feedback resistors. The number of segments required to adequately linearize the response varies from 6 for the "square-law" ranges down to 2 for the 3V range. The output of the shaping amplifier is +10V which drives the panel meter and is applied to the recorder terminals through a 9 kΩ resistor.

4.1.5 Chopper-Driver Circuits

The chopper-driver block provides all of the drive signals required by the instrument. The chopper frequency is obtained by dividing the output of a unijunction oscillator by two. The oscillator also generates the switching pulse for the synchronous detector. Diode gating feeds the pulse to the proper JFET depending upon chopper phase. The chopper frequency is normally adjusted to 94 Hz, but can be changed as much as ±10 Hz to avoid beating with harmonically related ground signals.

4.1.6 Power Supply

The power supply converts the ac input power to regulated +15V and -15V outputs. Each supply is protected by current limiting against accidental short circuits. Both supplies are adjustable to 15.0 ± 0.1V.

4.1.7 Programming

The instrument is organized around an eight-line ranging system. In each functional subcircuit the switching is accomplished by solid-state devices, generally JFET's, which are actuated by the appropriate range line. The front panel range switch simply connects to the eight range lines to allow range selection. The range lines are buffered by a logic level converter. The instrument may be externally ranged by a logic "0" command on the appropriate range line and manual disable line. (It is recommended that an Amphenol connector, or equivalent, be used for remote programming connection.)

CHAPTER V

MAINTENANCE

NOTE: Values and tolerances shown in this section are not specifications but are provided only as guides to the maintenance and calibration of this instrument.

5.1 PERIODIC CALIBRATION

The Model 92B is designed to provide trouble-free operation over extended periods of time. However, as with any precision instrument, the instrument should be checked periodically to verify proper calibration. To make such calibration checks, the following equipment is required:

a. A reliable signal source of 200 kHz to 500 kHz with less than 1% distortion at levels up to 3 volts across 50 ohms.

b. A precision voltmeter such as the Ballantine Model 310A or 300H, the Boonton Electronics Model 93A or 93AD, or the Hewlett-Packard Model 400D or 400H or equivalent.

NOTE: A Boonton Model 26A RF Millivoltmeter Calibrator can be substituted for items a. and b. above. This calibrator provides 1 MHz voltages from 60 μV to 3 V with an uncertainty of < ± 0.5% of indication. Full scale voltages in a 1 - 3 - 10 sequence can be switch-selected. On any range, incremental voltages can also be selected in 10% fs steps.

c. A precision dc voltmeter capable of measuring ±15.0V with an accuracy of 0.25%.

d. Frequency counter such as Monsanto Model 100A.

5.2 PRECAUTIONS WHEN CHECKING CALIBRATION

When checking the calibration of an instrument having the sensitivity and bandwidth of the Model 92B, it is essential to take precautions against errors resulting from stray pick-up voltages. (See paragraph 3.3.8.) A well-shielded signal source must be used in conjunction with coaxial connections to both the Model 92B and the standard reference meter. Even with a well-shielded generator and connections, it is sometimes possible for the reference meter to pick up stray rf signals and feed them into the probe. It is advisable to test for this condition by disconnecting the standard meter and noting any change in level.

5.3 CALIBRATION CHECK

Using the equipment listed in paragraph 5.1, check the calibration of the Model 92B on each range using a test voltage equal to the full scale value. If the check reveals that recalibration is required, the procedure outlined in paragraph 5.4 should be followed.

5.4 CALIBRATION PROCEDURE

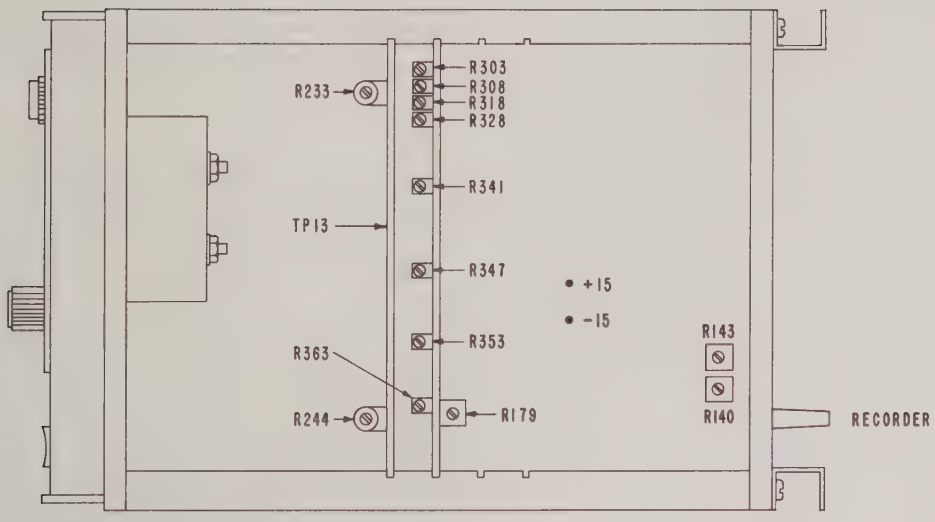
The Model 92B should be calibrated at room temperature (74°F) after a minimum warm-up time of five minutes.

A calibration outline is provided inside the top cover of the instrument (see Figure 9). The adjustment references listed below are the same as those recorded on the top cover.

Adjustment No. 1. Measure the -15.0 V supply voltage at the 15 V Test Point located on the Main Amplifier board at C119. Adjust R143 to -15.0 ± 0.1 V.

Adjustment No. 2. Measure the +15.0 V supply voltage at the +15 V Test Point located on the Main Amplifier board at C118. Adjust R140 for a reading of +15.0 ± 0.1 V.

Adjustment No. 3. Set the FULL SCALE range selector to the 1000 mV range, apply 1000 mV input and measure the chopper frequency at Test Point 13, located on the Chopper-Driver board. Adjust R244 for a frequency of 94 ± 1 Hz (106.4 mS). In some cases it may be desirable to offset the chopper frequency to avoid beating with a



• TEST POINT
+ REPEAT STEP #4

ADJ NO	CONT	FUNCTION	RANGE	INPUT ±0.2%	ADJUST
1	R143	-15 V ADJ	—	0	-15.0V ±0.1V AT -15V TP
2	R140	+15 V ADJ	—	0	+15.0V ±0.1V AT +15V TP
3	R244	CHOPPER FREQUENCY	1000 mV	1000 mV	94±1Hz AT TP 13
4	R401	FRONT PANEL ZERO	1 mV	0	AVERAGE ZERO INDICATION
5	R233	DC ZERO	30 mV	0	ZERO INDICATION
6	R353	RANGE ADJ	1000 mV	1000 mV	+10.00V AT RECORDER TERMINALS DC VOLTMETER INPUT >10 M OHMS
7	R179	METER FS ADJ	1000 mV	1000 mV	1000 mV INDICATION
8	R363	RANGE ADJ	3000 mV	3000 mV	3000 mV INDICATION
9 +	R303	RANGE ADJ	1 mV	1 mV	1.000 mV INDICATION
10+	R308	RANGE ADJ	3 mV	3 mV	3.000 mV INDICATION
11+	R318	RANGE ADJ	10 mV	10 mV	10.00 mV INDICATION
12	R328	RANGE ADJ	30 mV	30 mV	30.00 mV INDICATION
13	R341	RANGE ADJ	100 mV	100 mV	100.0 mV INDICATION
14	R347	RANGE ADJ	300 mV	300 mV	300.0 mV INDICATION

Figure 9. Calibration Instructions

harmonic of the power line frequency. Any frequency within the adjustment range will not degrade the performance of the instrument.

Adjustment No. 4. Set the FULL SCALE range selector to the 1 mV range and zero the instrument as described in paragraph 3.3.5

Adjustment No. 5. Set the FULL SCALE range selector to the 30 mV range and adjust R233 for a zero reading at the RECORDER terminals on the back panel.

Adjustment No. 6. Set the FULL SCALE range selector to the 1000 mV range and apply 1000 mV input; adjust R353 for +10.00 V at the RECORDER terminals.

Adjustment No. 7. Set the FULL SCALE range selector to the 1000 mV range and apply 1000 mV input; adjust R179 for a 1000 mV indication.

Adjustment No. 8. Set the FULL SCALE range selector to the 3000 mV range and apply 3000 mV input; adjust R363 for a 3000 mV indication.

Adjustment No. 9. Set the FULL SCALE range selector to the 1 mV range (zero the instrument as in Adjustment No. 4), apply 1.000 mV input, and adjust R303 for a reading of 1.000 mV.

Adjustment No. 10. Set the FULL SCALE range selector to the 3 mV range (zero as in Adjustment No. 4), apply 3.000 mV input, and adjust R308 for a reading of 3.000 mV.

Adjustment No. 11. Set the FULL SCALE range selector to the 10 mV range (zero as in Adjustment No. 4), apply 10.00 mV, and adjust R318 for a reading of 10.00 mV.

Adjustment No. 12. Set the FULL SCALE range selector to the 30 mV range, apply 30.00 mV input, and adjust R328 for a reading of 30.00 mV.

Adjustment No. 13. Set the FULL SCALE range selector to the 100 mV range, apply 100.0 mV input, and adjust R341 for a reading of 100.0 mV.

Adjustment No. 14. Set the FULL SCALE range selector to the 300 mV range, apply 300.0 mV input, and adjust R347 for an indication of 300.0 mV.

5.5 TROUBLE-SHOOTING PROCEDURE

The following trouble-shooting procedures describe the instrument's cover removal, chopper replacement and voltage and resistance tests.

5.5.1 Cover Removal

The cover of the instrument may be removed from the case by removing the screw on the top of the case.

5.5.2 Chopper Replacement

If unsatisfactory operation of the Model 92B develops, a replacement chopper should be tried. (NOTE: The chopper used in the Model 92B is a special Boonton Electronics Corporation part. For replacements or spares, call your local Boonton Electronics Representative, or the factory.) If the new chopper does not clear the difficulty, place the original chopper back in the socket. The calibration accuracy should be re-checked after replacement.

5.5.3 Voltage and Resistance Tests

After determining that the trouble cannot be cured by replacement of the chopper (as noted above) it is advisable to make a systematic check of the ac voltage, dc voltage, and resistance. Once the trouble has been found and corrected, the calibration must be re-checked and readjusted as outlined in paragraphs 5.3 and 5.4.

5.5.4 Test Points

Test points, waveforms, and related test voltages are shown in the Model 92B schematics.

5.5.5 Replacement of RF Probes

The serial number of the Model 92B matches that of the Model 91-12F RF Probe with which it was calibrated at the factory. If it is necessary to change probes for any reason, the instrument's calibration MUST be re-checked. In most cases, full recalibration (see procedure in paragraph 5.4) will be required. Similarly, if the RF Probe

supplied with the instrument is exchanged for a Model 91-4C Low Frequency Probe, recalibration will be required. (See paragraph 3.5)

5.5.6 Probe Tests

The probe assemblies furnished with the Model 92B can be checked for VSWR and frequency response by following the procedures detailed in the paragraphs below.

Should a probe exhibit out-of-tolerance performance in these tests, the user is urged not to attempt repair himself but to send it back to the factory for repair or adjustment.

A. VSWR measurement:

1. Test Equipment:

a. Oscillator for desired frequency range:
56 - 500 MHz: GR Type 1363
220 - 920 MHz: GH Type 1362
450 - 1050 MHz: GR Type 1361A

b. Oscillator Power Supply: GR Type 1263-C

c. GR Voltmeter Rectifier Type 874-VR

d. Slotted Line: GR Type 900 LB

e. RF VTVM: BEC Model 91H, 91DA, 92B, or GR Detector Type 1241

f. Tee Adapter: BEC Model 91-14A

g. 50-ohm Termination: BEC Model 91-15A

2. Test Procedure:

a. Assemble the equipment as shown in the block diagram following this section.

b. Set the oscillator to the desired test frequency and adjust the output level for a reading of approximately half-scale on the 30 mV voltmeter range.

c. Adjust the carriage of the slotted line to a point of minimum voltage on the meter, and record the value.

d. Adjust the carriage to a maximum-voltage point and record this value.

e. The VSWR is equal to the ratio of the two voltages recorded in steps c and d.

f. The measurement may be repeated at other frequencies as required.

B. Frequency Response

1. Test Equipment:

a. Oscillator for desired frequency range:
56 - 500 MHz: GR Type 1363
220 - 920 MHz: GR Type 1362
450 - 1050 MHz: GR Type 1361A

b. Power supply: GR Type 1263-C

c. GR Voltmeter Rectifier Type 874-VR

d. 1.0 GHz Low-Pass Filter: GR Type 874-F100L

e. 20 dB 50-Ω Pad: GR Type 874-G20

f. BEC Model 91-14A Tee Adapter

g. BEC Model 91-15A 50-ohm termination

h. BEC Model 92B R F Millivoltmeter

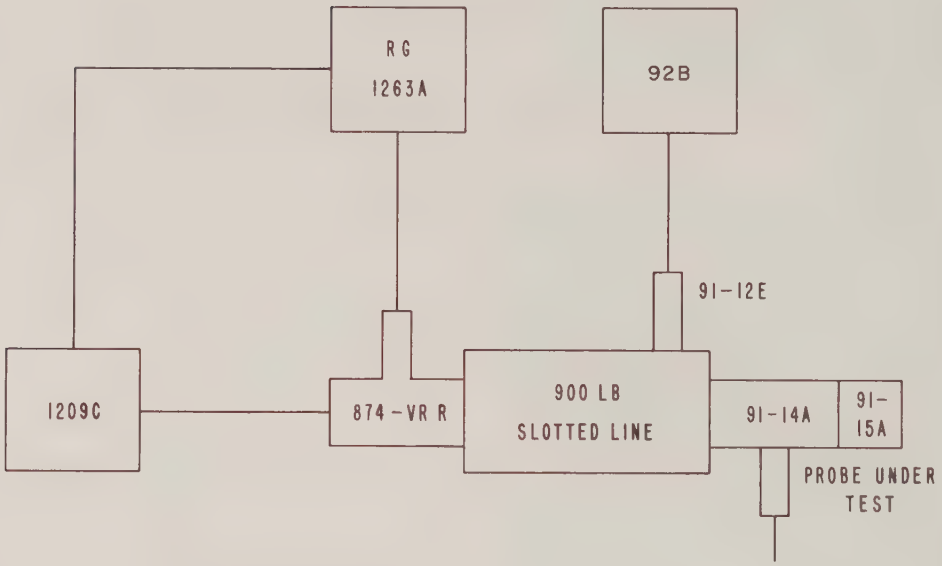
2. Test Procedure:

a. Assemble the equipment as shown in the block diagram following this section.

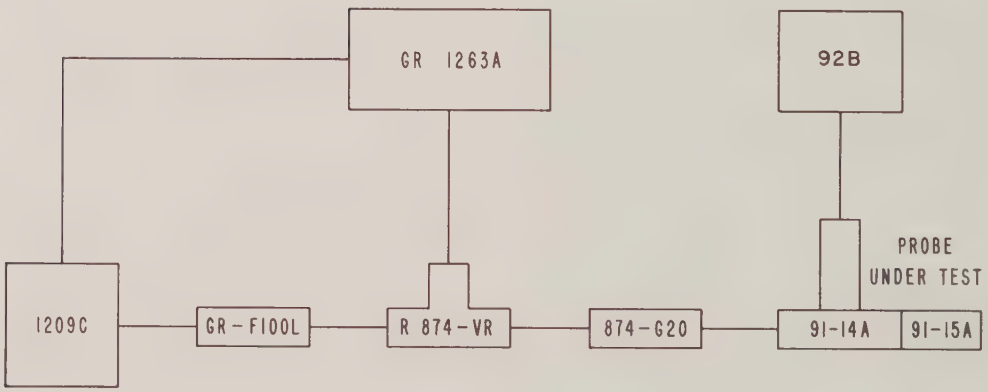
b. Set the oscillator to the low-frequency end of its tuning range and the voltmeter to the 100 mV range. Adjust the oscillator power to give a reading of 0 dBm on the meter.

c. Adjust the oscillator to successively higher frequencies as convenient, recording the voltmeter reading at each frequency. The results may be plotted on a graph, if desired.

BLOCK DIAGRAM OF RF PROBE VSWR TEST



BLOCK DIAGRAM OF RF PROBE RESPONSE TEST



CHAPTER VI

INTERFACE

PROGRAMMING INPUTS AND DATA OUTPUT

Pin No.	Function	Comment	Command	Unit Loading
7	Man. disable	Disables front panel range selection	0	0.1
16	1mV range	Selects range provided manual dis-	0	0.1
15	3mV "	able has also been selected; select-	0	0.1
14	10mV "	ing more than one range will result	0	0.1
13	30mV "	in incorrect indications. Range lines	0	0.1
12	100mV "	must be deselected for manual oper-	0	0.1
11	300mV "	ation.	0	0.1
10	1 V "		0	0.1
9	3 V "		0	0.1
5	Common	Power line ground at rear panel	N/A	N/A
4	DC Analog	+10V for full scale of "1" ranges +9.5V for "3" ranges	N/A	N/A

Figure 10. Pin Designations

6.1

Input Characteristics

TTL Series	Logic Level	Voltage Level	Current per Unit Load
Standard Power 54/74	0	± 0.7 V	-1.6 mA*
	1	2.4 to 5.25V	40μA

*The - current indicates current out of the input (external command device must sink this current). A standard power (Series 54/74) TTL output will sink and source 10 unit loads.

6.2

Input Pull-Up

All input terminals have internal pull-up. The current sourced by this pull - up when the input is brought to a logic level 0 is included in the loading shown in the "Unit Loading" column of the chart.

6.3

Analog Output

Source resistance is = 9 KΩ

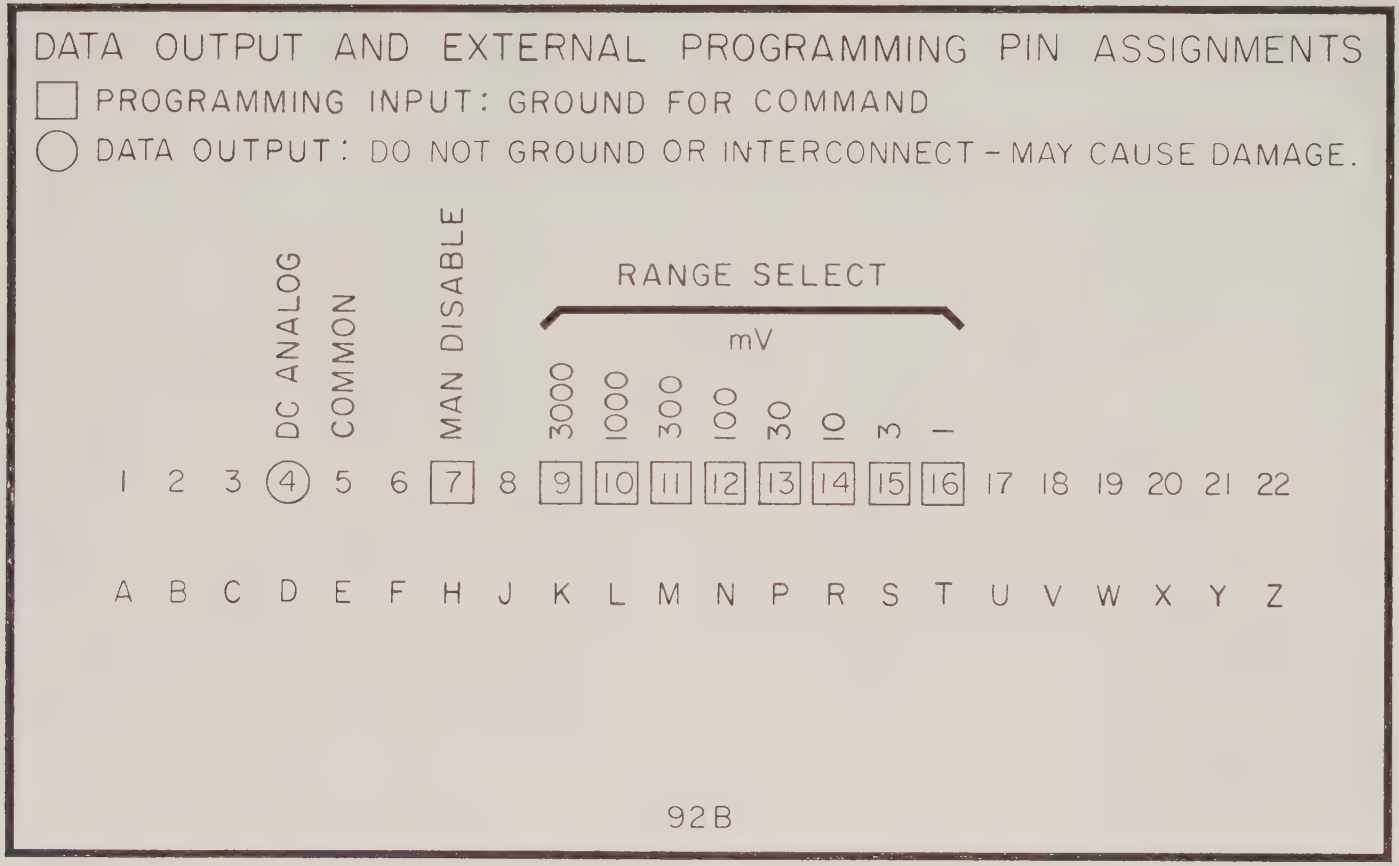

DATA OUTPUT AND EXTERNAL PROGRAMMING PIN ASSIGNMENTS
PROGRAMMING INPUT: GROUND FOR COMMAND
DATA OUTPUT: DO NOT GROUND OR INTERCONNECT - MAY CAUSE DAMAGE.
DC ANALOG COMMON
MAN DISABLE
RANGE SELECT
mV
3000
1000
300
100
30
10
3
—
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
A B C D E F H J K L M N P R S T U V W X Y Z
92B

Figure 11. External Connections

TABLE OF REPLACEABLE PARTS

Reference		Description	BEC Part No.
		AMPLIFIER P. C. BOARD	
C101	Capacitor, PE	100 nF ±10% 200 V	234005
C102	Capacitor, Elec.	10 µF ±20% 20 V	283205
C103	Capacitor, Mica	100 pF ±5% 500 V	200001
C104	Capacitor, Elec.	10 µF ±20% 20 V	283205
C105	Capacitor, Elec.	33 µF ±20% 15 V	283206
C106	Capacitor, Elec.	10 µF ±20% 20 V	283205
C107	Capacitor, Met.	1.0 µF ±20% 100 V	236007
C108	Capacitor, Elec.	1.0 µF ±20% 35 V	283199
C109	Capacitor, Elec.	50 µF +75/-10% 25 V	283159
C110	Capacitor, Elec.	50 µF +75/-10% 25 V	283159
C111	Capacitor, PE	100 nF ±10% 200 V	234005
C112	Capacitor, Elec.	250 µF 40 V	283207
C113	Capacitor, Elec.	250 µF 40 V	283207
C114	Not Used		
C115	Capacitor, Cer.	100 nF +80/-20% 25 V	224124
C116	Capacitor, Cer.	100 nF +80/-20% 25 V	224124
C117	Not Used		
C118	Capacitor, Elec.	100 µF +75/-10% 25 V	283105
C119	Capacitor, Elec.	100 µF +75/-10% 25 V	283105
CR101	Diode, Sig.	FD300	530052
CR102	Diode, Sig.	1N914	530058
CR103	Diode, Sig.	1N914	530058
CR104	Diode, Zener	1N5243B (13 V)	530101
CR105	Diode, Zener	1N5235B (6.8 V)	530089
CR106 through CR110	Diode, Sig.	1N914	530058
CR111	Bridge Rectifier	KBP-02	532013
CR112	Bridge Rectifier	KBP-02	532013
CR113	Not Used		
CR114	Not Used		
CR115	Diode, Sig.	1N914	530058
CR116	Not Used		
CR117 through CR124	Diode, Sig.	1N914	530058
IC101	Integrated Circuit	µA7805 Regulator	535011
IC102	Integrated Circuit	µA7805 Regulator	535011
IC103	Not Used		
IC104	Integrated Circuit	MFC6030A Regulator	535007
IC105	Integrated Circuit	MFC6030A Regulator	535007
J101	Receptacle	Amphenol No. 143-022-03 (22 pins)	479231
J102	Receptacle	Amphenol No. 143-022-03 (22 pins)	479231
Q101	Transistor, FET	2N5949	528019
Q102	Transistor, FET	2N5949	528019
Q103	Not Used		
Q104	Transistor, FET	2N5949	528019
Q105	Transistor, FET	TIS58	528038
Q106	Transistor, FET	HDGP1000	528066
Q107	Transistor, FET	HDGP1000	528066
Q108	Transistor, FET	2N5949	528019
Q109	Transistor, FET	Selected	528044

Reference	Description		BEC Part No.
	AMPLIFIER P. C. BOARD (CONTINUED)		
Q110	Transistor, NPN	2N5088	528047
Q111	Transistor, PNP	2N5087	528042
Q112	Transistor, PNP	MPSA66	528048
Q113	Transistor, PNP	2N5087	528042
Q114	Transistor, NPN	2N5088	528047
Q115	Transistor, FET	TIS58	528038
Q116	Transistor, FET	TIS58	528038
Q117	Transistor, FET	TIS58	528038
Q118	Transistor, FET	2N5949	528019
Q119	Transistor, FET	2N5949	528019
Q120	Transistor, FET	2N5949	528019
Q121	Transistor, PNP	MPSA66	528048
Q122	Transistor, PNP	MPS6516	528037
Q123	Not Used		
Q124 through Q131	Transistor, PNP	MPS6516	528037
R101	Resistor, Comp.	1 MΩ 5%	344600
R102	Resistor, Comp.	6.2 kΩ 5%	343376
R103	Resistor, Comp.	6.2 kΩ 5%	343376
R104	Resistor, MF	5.62 MΩ 1% 1/4 W	325397
R105	Resistor, MF	24.3 kΩ 1%	341437
R106	Resistor, MF	80.6 kΩ 1%	341487
R107	Resistor, MF	374 kΩ 1%	341555
R108	Resistor, MF	294 kΩ 1%	341545
R109	Resistor, MF	1.0 MΩ 1%	342600
R110	Resistor, Comp.	91 kΩ 5%	344492
R111	Resistor, Comp.	47 kΩ 5%	344465
R112	Resistor, Comp.	33 kΩ 5%	344450
R113	Resistor, Comp.	300 kΩ 5%	344546
R114	Resistor, MF	169 Ω 1%	341222
R115	Resistor, Comp.	10 kΩ 5%	344400
R116	Resistor, Comp.	10 kΩ 5%	344400
R117	Resistor, Comp.	33 kΩ 5%	344450
R118	Resistor, MF	15.0 kΩ 1%	341417
R119	Resistor, Comp.	15 kΩ 5%	344417
R120	Resistor, Comp.	3.6 kΩ 5%	344353
R121	Resistor, Comp.	3 kΩ 5%	344346
R122	Resistor, Comp.	1 MΩ 5%	344600
R123	Resistor, Comp.	2.7 kΩ 5%	344341
R124	Resistor, Comp.	5.6 kΩ 5%	344372
R125	Resistor, Comp.	5.6 kΩ 5%	344372
R126	Resistor, Comp.	1 kΩ 5%	344300
R127	Resistor, Comp.	5.1 kΩ 5%	344368
R128	Resistor, Comp.	15 kΩ 5%	344417
R129	Resistor, Comp.	1 kΩ 5%	344300
R130	Resistor, Comp.	10 kΩ 5%	344400
R131	Resistor, MF	30.1 kΩ 1%	341446
R132	Resistor, MF	3.01 kΩ 1%	341346
R133	Resistor, MF	301 Ω 1%	341246
R134	Resistor, MF	33.2 Ω 1%	341150
R135	Resistor, Comp.	1 MΩ 5%	344600
R136	Resistor, Comp.	1 kΩ 5%	344300
R137	Resistor, Comp.	1 kΩ 5%	344300
R138	Resistor, Comp.	15 kΩ 5%	344417
R139	Resistor, MF	1.62 kΩ 1%	341320
R140	Resistor, Var.	200 Ω ±10% 1/2 W	311304

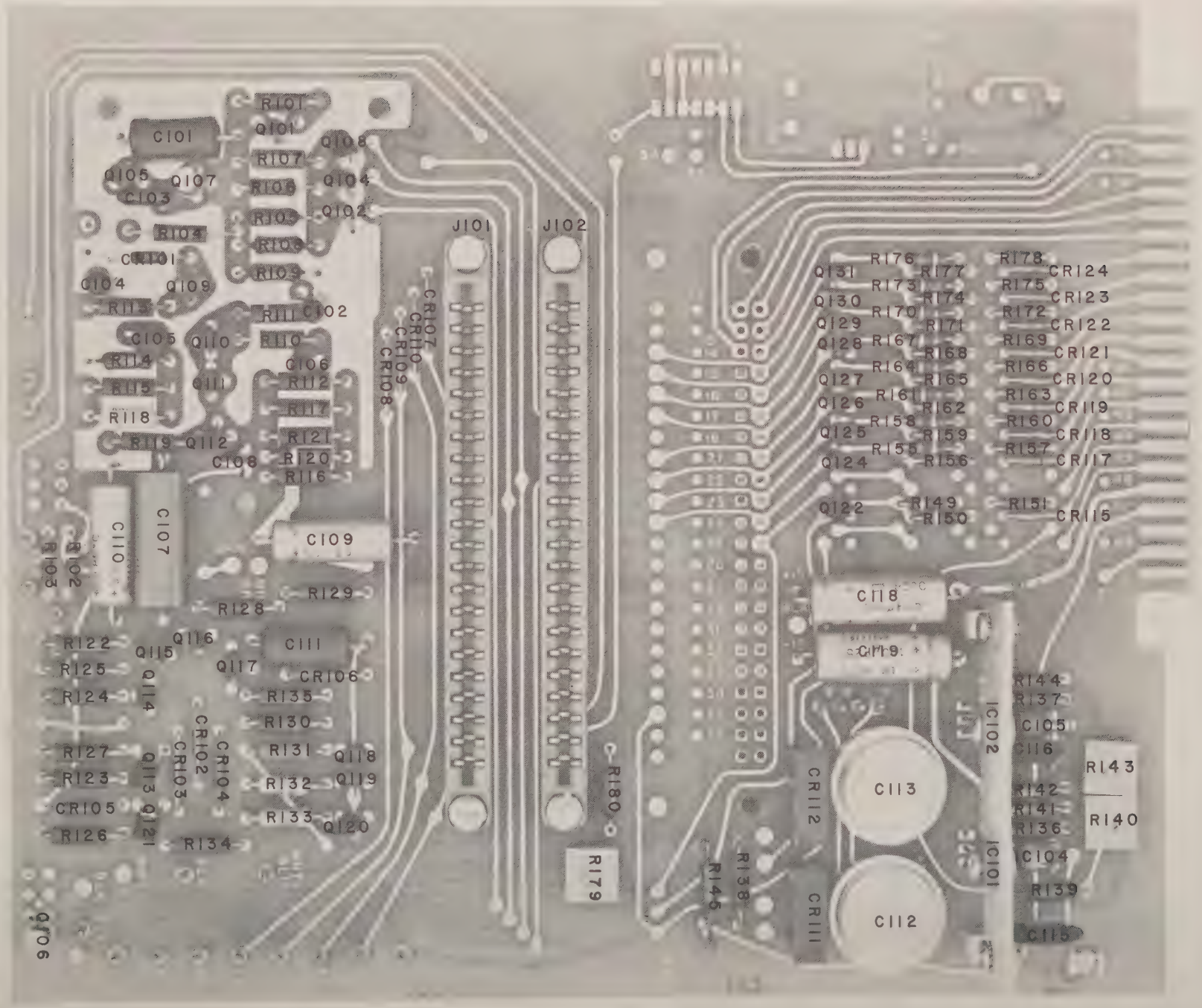
Reference	Description		BEC Part No.
	AMPLIFIER P. C. BOARD (CONTINUED)		
R141	Resistor, MF	604 Ω 1%	341275
R142	Resistor, MF	1.62 kΩ 1%	341320
R143	Resistor, Var.	200 Ω ±10% 1/2 W	311304
R144	Resistor, MF	604 Ω 1%	341275
R145	Resistor, MF	9.09 kΩ 1%	341392
R146	Not Used		
R147	Not Used		
R148	Not Used		
R149	Resistor, Comp.	160 kΩ 5%	343520
R150	Resistor, Comp.	39 kΩ 5%	343457
R151	Resistor, Comp.	100 kΩ 5%	343500
R152	Not Used		
R153	Not Used		
R154	Not Used		
R155	Resistor, Comp.	160 kΩ 5%	343520
R156	Resistor, Comp.	39 kΩ 5%	343457
R157	Resistor, Comp.	100 kΩ 5%	343500
R158	Resistor, Comp.	160 kΩ 5%	343520
R159	Resistor, Comp.	39 kΩ 5%	343457
R160	Resistor, Comp.	100 kΩ 5%	343500
R161	Resistor, Comp.	160 kΩ 5%	343520
R162	Resistor, Comp.	39 kΩ 5%	343457
R163	Resistor, Comp.	100 kΩ 5%	343500
R164	Resistor, Comp.	160 kΩ 5%	343520
R165	Resistor, Comp.	39 kΩ 5%	343457
R166	Resistor, Comp.	100 kΩ 5%	343500
R167	Resistor, Comp.	160 kΩ 5%	343520
R168	Resistor, Comp.	39 kΩ 5%	343457
R169	Resistor, Comp.	100 kΩ 5%	343500
R170	Resistor, Comp.	160 kΩ 5%	343520
R171	Resistor, Comp.	39 kΩ 5%	343457
R172	Resistor, Comp.	100 kΩ 5%	343500
R173	Resistor, Comp.	160 kΩ 5%	343520
R174	Resistor, Comp.	39 kΩ 5%	343457
R175	Resistor, Comp.	100 kΩ 5%	343500
R176	Resistor, Comp.	160 kΩ 5%	343520
R177	Resistor, Comp.	39 kΩ 5%	343457
R178	Resistor, Comp.	100 kΩ 5%	343500
R179	Resistor, Var.	10 kΩ 10% 1/2 W	311328
R180	Resistor, MF	46.4 kΩ 1%	341464
	CHOPPER DRIVER P. C. BOARD		
A201	Op. Amp.	LM302H	535003
C201	Capacitor, PC	100 nF ±10% 50 V	234046
C202	Capacitor, PE	6.8 nF ±10% 200 V	234044
C203	Capacitor, Mica	100 pF ±5% 500 V	200001
C204	Capacitor, Mica	100 pF ±5% 500 V	200001
C205	Capacitor, PE	22 nF ±10% 200 V	230101
C206	Capacitor, PC	100 nF ±10% 50 V	234046
C207	Capacitor, Mica	100 pF ±5% 500 V	200001
C208	Capacitor, PC	100 nF ±10% 50 V	234046
C209	Capacitor, Cer.	10 nF 100 V	224119
C210	Capacitor, Cer.	10 nF 100 V	224119
C211	Capacitor, PE	22 nF ±10% 200 V	230101
C212	Capacitor, PC	470 nF ±10% 80 V	234128
C213	Capacitor, Mica	100 pF ±5% 500 V	200001

Reference	Description		BEC Part No.
	CHOPPER DRIVER P. C. BOARD (CONTINUED)		
C214	Capacitor, Elec.	50 μF +75/-10% 25 V	283159
C215	Capacitor, Elec.	50 μF +75/-10% 25 V	283159
C216	Capacitor, Elec.	50 μF +75/-10% 25 V	283159
C217	Capacitor, Elec.	150 μF +75/-10% 15 V	283307
CR201 through CR218	Diode, Sig.	1N914	530058
CR219	Diode, Sig.	FD-300	530052
Q201	Transistor, Unijunction	2N4871	528051
Q202	Transistor, NPN	MPS-A20	528043
Q203	Transistor, PNP	2N5087	528042
Q204	Transistor, NPN	2N5088	528047
Q205	Transistor, NPN	MPS-A20	528043
Q206	Transistor, FET	MPS-A12	528052
Q207	Transistor, NPN	MPS-A20	528043
Q208	Transistor, FET	Selected	528093
Q209	Transistor, NPN	MPS-A20	528043
Q210	Transistor, FET	Selected	528093
Q211	Transistor, FET	2N5949	528019
Q212	Transistor, NPN	MPS-A20	528043
Q213	Transistor, NPN	2N5308	528050
Q214	Transistor, NPN	2N5308	528050
R201	Resistor, Comp.	10 kΩ 5%	344400
R202	Resistor, Comp.	22 kΩ 5%	344433
R203	Resistor, Comp.	10 kΩ 5%	344400
R204	Resistor, Comp.	100 Ω 5%	344200
R205	Resistor, Comp.	33 kΩ 5%	344450
R206	Resistor, Comp.	10 kΩ 5%	344400
R207	Resistor, Comp.	100 kΩ 5%	344500
R208	Resistor, Comp.	3.3 kΩ 5%	344350
R209	Resistor, Comp.	4.7 kΩ 5%	344365
R210	Resistor, Comp.	10 kΩ 5%	344400
R211	Resistor, Comp.	150 kΩ 5%	344517
R212	Resistor, Comp.	10 kΩ 5%	344400
R213	Resistor, Comp.	10 kΩ 5%	344400
R214	Resistor, Comp.	22 kΩ 5%	344433
R215	Resistor, Comp.	10 kΩ 5%	344400
R216	Resistor, Comp.	270 kΩ 5%	344541
R217	Resistor, Comp.	240 kΩ 5%	344537
R218	Resistor, Comp.	10 kΩ 5%	344400
R219	Resistor, Comp.	15 kΩ 5%	344417
R220	Resistor, Comp.	10 kΩ 5%	344400
R221	Resistor, Comp.	10 kΩ 5%	344400
R222	Resistor, Comp.	10 kΩ 5%	344400
R223	Resistor, Comp.	4.7 kΩ 5%	344365
R224	Resistor, Comp.	12 kΩ 5%	344408
R225	Resistor, Comp.	100 kΩ 5%	344500
R226	Resistor, Comp.	100 kΩ 5%	344500
R227	Resistor, Comp.	15 kΩ 5%	344417
R228	Resistor, Comp.	10 kΩ 5%	344400
R229	Resistor, Comp.	100 kΩ 5%	344500
R230	Resistor, Comp.	12 kΩ 5%	344408
R231	Resistor, Comp.	4.7 kΩ 5%	344365
R232	Resistor, Comp.	100 kΩ 5%	344500
R233	Resistor, Var.	2 kΩ 20% 1/2 W	311285
R234	Resistor, Comp.	100 kΩ 5%	344500

Reference	Description		BEC Part No.
	CHOPPER DRIVER P. C. BOARD (CONTINUED)		
R235	Resistor, Comp.	100 kΩ 5%	344500
R236	Resistor, Comp.	27 kΩ 5%	344441
R237	Resistor, Comp.	100 kΩ 5%	344500
R238	Resistor, Comp.	100 kΩ 5%	344500
R239	Resistor, Comp.	1.6 kΩ 5%	344320
R240	Resistor, Comp.	300 Ω 5%	344246
R241	Resistor, Comp.	62 Ω 5% 1 W	302072
R242	Resistor, Comp.	150 kΩ 5%	344517
R243	Resistor, Comp.	510 kΩ 5%	344568
R244	Resistor, Var.	50 kΩ 20% 1/2 W	311282
R245	Resistor, Comp.	47 Ω 5%	344165
	SHAPING AMPLIFIER P. C. BOARD		
A301	Op. Amp.	LM301AN	535012
C301	Capacitor, Cer.	10 nF 100 V	224119
C302	Capacitor, Mica	33 pF ±5% 500 V	200049
C303	Capacitor, Cer.	10 nF 100 V	224119
CR301 through CR308	Diode, Sig.	1N914	530058
Q301	Transistor, FET	2N5949	528019
Q302	Transistor, FET	2N5949	528019
Q303	Transistor, FET	2N5949	528019
Q304	Transistor, PNP	2N5087	528042
Q305	Transistor, FET	2N5949	528019
Q306	Transistor, PNP	2N5087	528042
Q307	Transistor, FET	2N5949	528019
Q308	Transistor, PNP	2N5087	528042
Q309	Transistor, FET	2N5949	528019
Q310	Transistor, PNP	2N5087	528042
Q311	Transistor, FET	2N5949	528019
Q312	Transistor, PNP	2N5087	528042
Q313 through Q316	Transistor, FET	2N5949	528019
Q317	Transistor, PNP	2N5087	528042
Q318	Transistor, NPN	2N5088	528047
Q319	Transistor, PNP	2N5087	528042
Q320	Transistor, NPN	2N5088	528047
Q321	Transistor, PNP	2N5087	528042
Q322	Transistor, PNP	2N5087	528042
Q323	Transistor, FET	2N5949	528019
Q324	Transistor, FET	2N5949	528019
Q325	Transistor, PNP	2N5087	528042
Q326	Transistor, FET	2N5949	528019
Q327	Transistor, PNP	2N5087	528042
Q328	Transistor, FET	2N5949	528019
Q329	Transistor, PNP	2N5087	528042
Q330	Transistor, FET	2N5949	528019
Q331	Transistor, FET	2N5949	528019
Q332	Transistor, PNP	2N5087	528042
Q333	Transistor, PNP	2N5087	528042
Q334	Transistor, PNP	2N5087	528042
Q335	Transistor, FET	2N5949	528019

Reference	Description		BEC Part No.
	SHAPING AMPLIFIER P. C. BOARD (CONTINUED)		
Q336	Transistor, FET	2N5949	528019
Q337	Transistor, PNP	2N5087	528042
Q338	Transistor, PNP	2N5087	528042
Q339	Transistor, PNP	2N5087	528042
R301	Resistor, Comp.	130 Ω 5%	344211
R302	Resistor, Comp.	4.7 MΩ 5%	344665
R303	Resistor, Var.	1 kΩ 10% 1 W	311256
R304	Resistor, MF	10 kΩ ±1%	341400
R305	Resistor, Comp.	4.7 MΩ 5%	344665
R306	Resistor, MF	53.6 kΩ ±1%	341470
R307	Resistor, MF	2.49 kΩ ±1%	341338
R308	Resistor, Var.	1 kΩ 10% 1 W	311256
R309	Resistor, MF	28.7 kΩ ±1%	341444
R310	Resistor, MF	200 kΩ ±1%	341529
R311	Resistor, MF	100 kΩ ±1%	341500
R312	Resistor, MF	40.2 kΩ ±1%	341458
R313	Resistor, MF	191 kΩ ±1%	341527
R314	Resistor, MF	11 kΩ ±1%	341404
R315	Resistor, Comp.	4.7 MΩ 5%	344665
R316	Resistor, MF	29.4 kΩ ±1%	341445
R317	Resistor, MF	95.3 kΩ ±1%	341494
R318	Resistor, Var.	1 kΩ 10% 1 W	311256
R319	Resistor, MF	28.0 kΩ ±1%	341443
R320	Resistor, MF	64.9 kΩ ±1%	341478
R321	Resistor, MF	1.00 MΩ ±1%	342600
R322	Resistor, MF	26.1 kΩ ±1%	341440
R323	Resistor, MF	46.4 kΩ ±1%	341464
R324	Resistor, MF	10 kΩ ±1%	341400
R325	Resistor, Comp.	4.7 MΩ 5%	344665
R326	Resistor, MF	45.3 kΩ ±1%	341463
R327	Resistor, MF	2.49 kΩ ±1%	341338
R328	Resistor, Var.	1 kΩ 10% 1 W	311256
R329	Resistor, Comp.	270 kΩ 5%	344541
R330	Resistor, MF	21.5 kΩ ±1%	341432
R331	Resistor, MF	237 kΩ ±1%	341536
R332	Resistor, Comp.	18 kΩ 5%	344425
R333	Resistor, MF	26.1 kΩ ±1%	341440
R334	Resistor, MF	154 kΩ ±1%	341518
R335	Resistor, Comp.	47 kΩ 5%	344465
R336	Resistor, MF	54.9 kΩ ±1%	341471
R337	Resistor, MF	191 kΩ ±1%	341527
R338	Resistor, Comp.	4.7 MΩ 5%	344665
R339	Resistor, MF	82.5 kΩ ±1%	341488
R340	Resistor, MF	178 kΩ ±1%	341524
R341	Resistor, Var.	1 kΩ 10% 1 W	311256
R342	Resistor, MF	17.8 kΩ ±1%	341424
R343	Resistor, MF	2.74 kΩ ±1%	341342
R344	Resistor, Comp.	4.7 MΩ 5%	344665
R345	Resistor, MF	24.3 kΩ ±1%	341437
R346	Resistor, MF	232 kΩ ±1%	341535
R347	Resistor, Var.	1 kΩ 10% 1 W	311256
R348	Resistor, MF	95.3 kΩ ±1%	341494
R349	Resistor, MF	453 kΩ ±1%	341563
R350	Resistor, Comp.	4.7 MΩ 5%	344665
R351	Resistor, MF	200 kΩ ±1%	341529
R352	Resistor, MF	634 kΩ ±1%	342577
R353	Resistor, Var.	1 kΩ 10% 1 W	311256
R354	Resistor, MF	14.3 kΩ ±1%	341415

Reference		Description	BEC Part No.
		SHAPING AMPLIFIER P. C. BOARD (CONTINUED)	
R355	Resistor, MF	2.49 kΩ ±1%	341338
R356	Resistor, MF	34.8 kΩ ±1%	341452
R357	Resistor, MF	523 kΩ ±1%	342569
R358	Resistor, Comp.	4.7 MΩ 5%	344665
R359	Resistor, MF	162 kΩ ±1%	341520
R360	Resistor, MF	806 kΩ ±1%	342587
R361	Resistor, MF	10 kΩ ±1%	341400
R362	Resistor, MF	2.74 kΩ ±1%	341342
R363	Resistor, Var.	1 kΩ 10% 1 W	311256
R364	Resistor, MF	127 kΩ ±1%	341510
R365	Resistor, MF	604 kΩ ±1%	342575
RT301	Thermistor	100 Ω ±10%	325005
		CHOPPER SOCKET	
C401	Capacitor, Mylar	100 nF 10% 50 V	234046
C402	Capacitor, Mylar	100 nF 10% 50 V	234046
		SUB PANEL	
DS401	Lamp	Tung-Sol No. 349 (6.3 V)	545107
DS402	Lamp	Tung-Sol No. 349 (6.3 V)	545107
G401	Chopper	Special	540113
J401	Receptacle	Amphenol No. 80-PC-2FT	479119
M401	Meter & Scale	API	554216
R401	Resistor, Var.	5 kΩ 20% 2 W	311255
S401	Switch, Pushbutton	Centralab	465146
		REAR PANEL	
F401	Fuse, Slo Blo	1/10 Amp 250 V	545519
F401	Fuse, Slo Blo	1/16 Amp 250 V	545518
S402	Switch, Slide	Switchcraft	465134
T401	Power Transformer	Boonton Electronics	446068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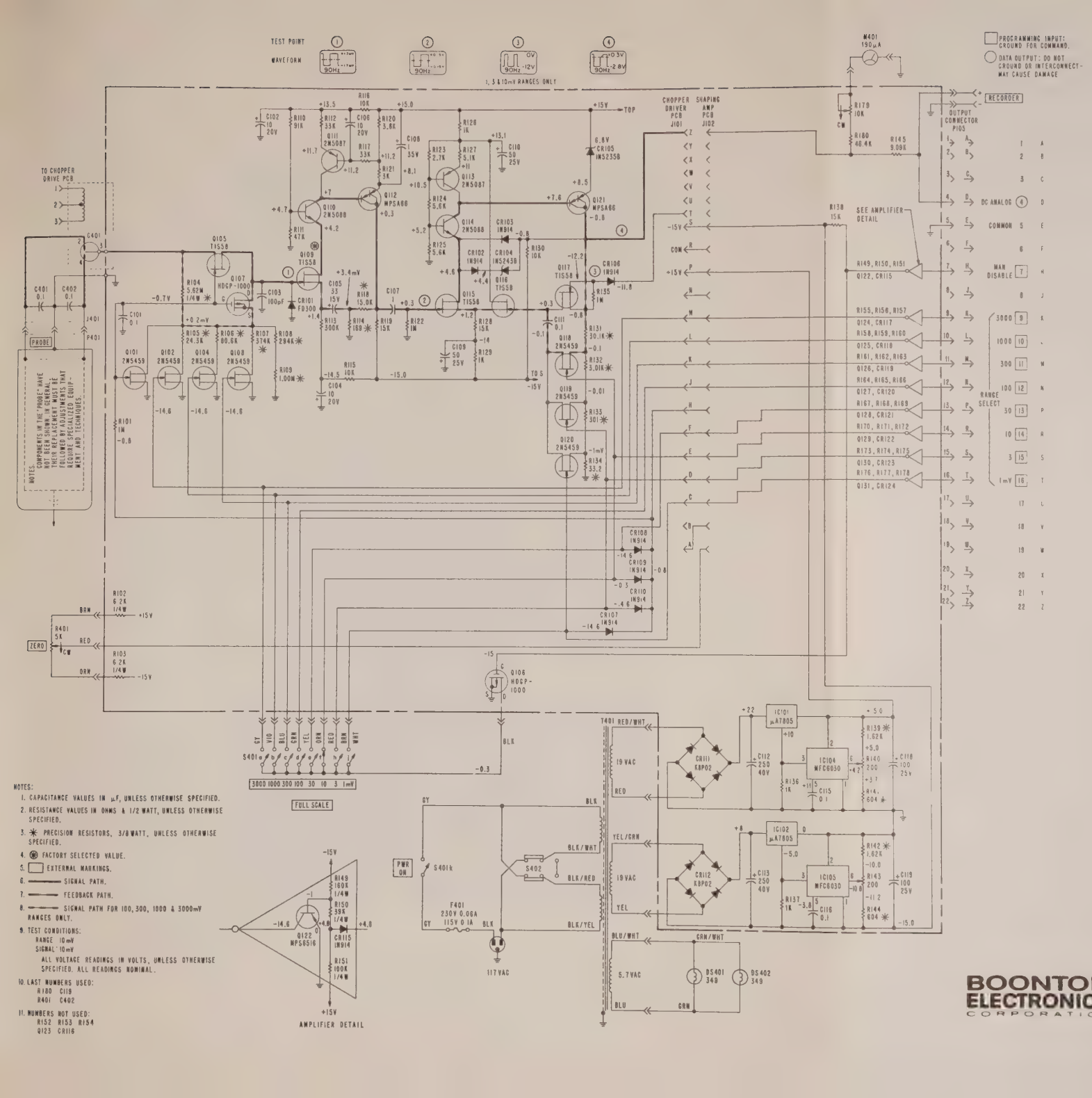
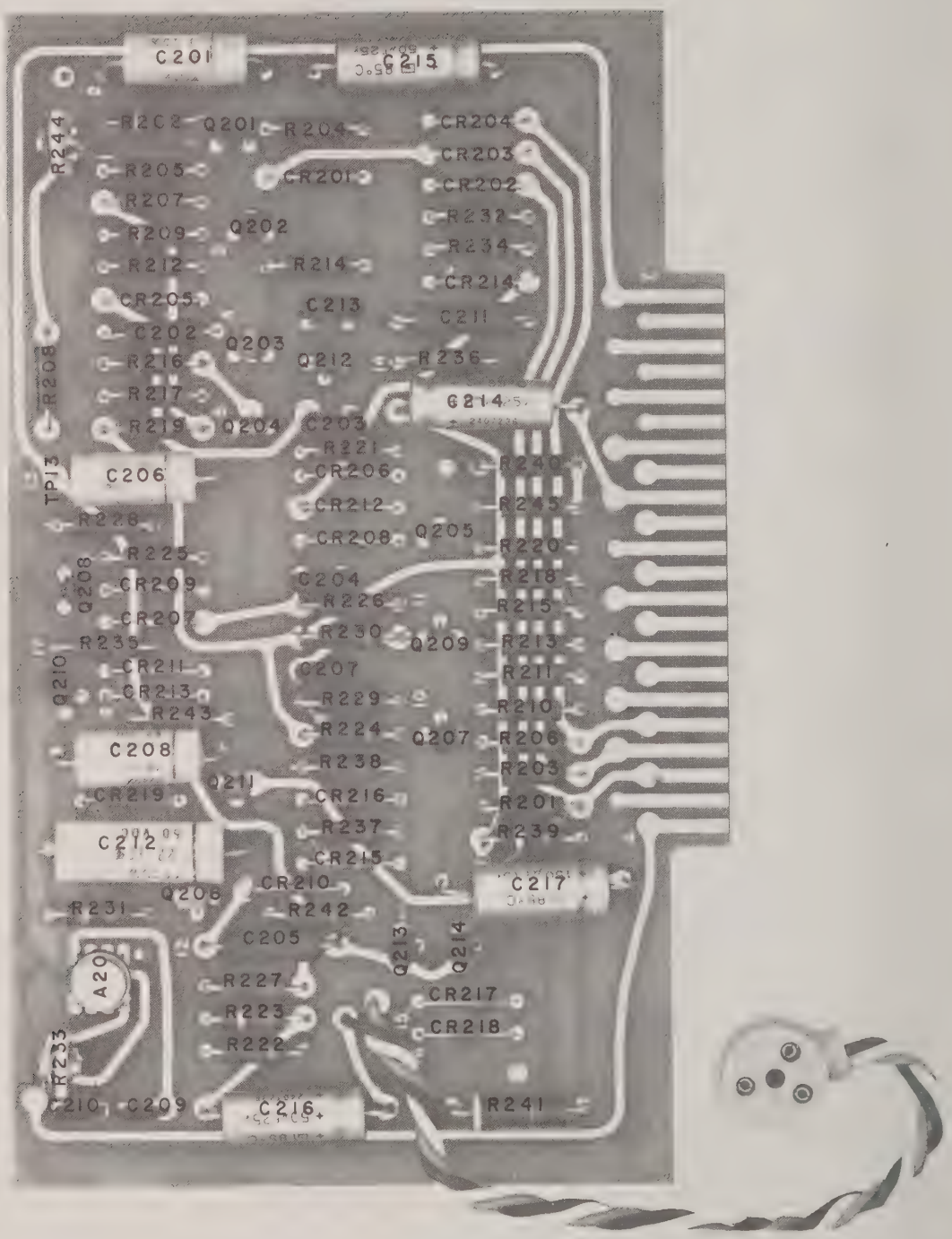


BOONTON ELECTRONICS CORPORATION

MODEL 92B
Amplifier Schematic
E830605A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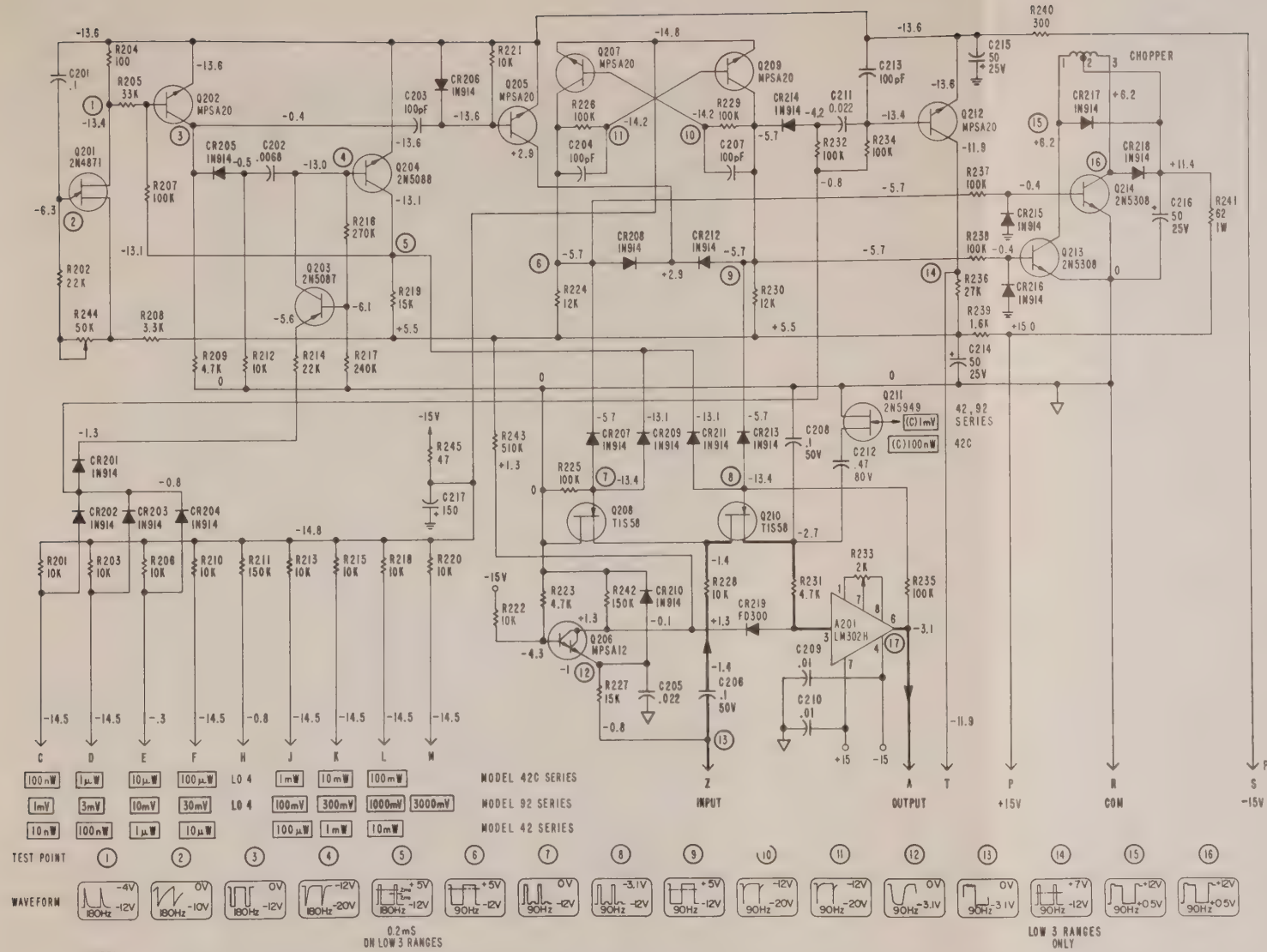


P101
CONNECTS TO J101
ON AMP. BD. 565675

INSTRUMENT	SCHEMATIC
42B	830636
42BB	830658 SHT. 1
42BD	830592 SHT. 1
42B-18	830640
42B-19	830641
92B	830605
92BD	830581 SHT. 1
42C	830636
42CD	830592 SHT. 1
42CB	830658 SHT 1

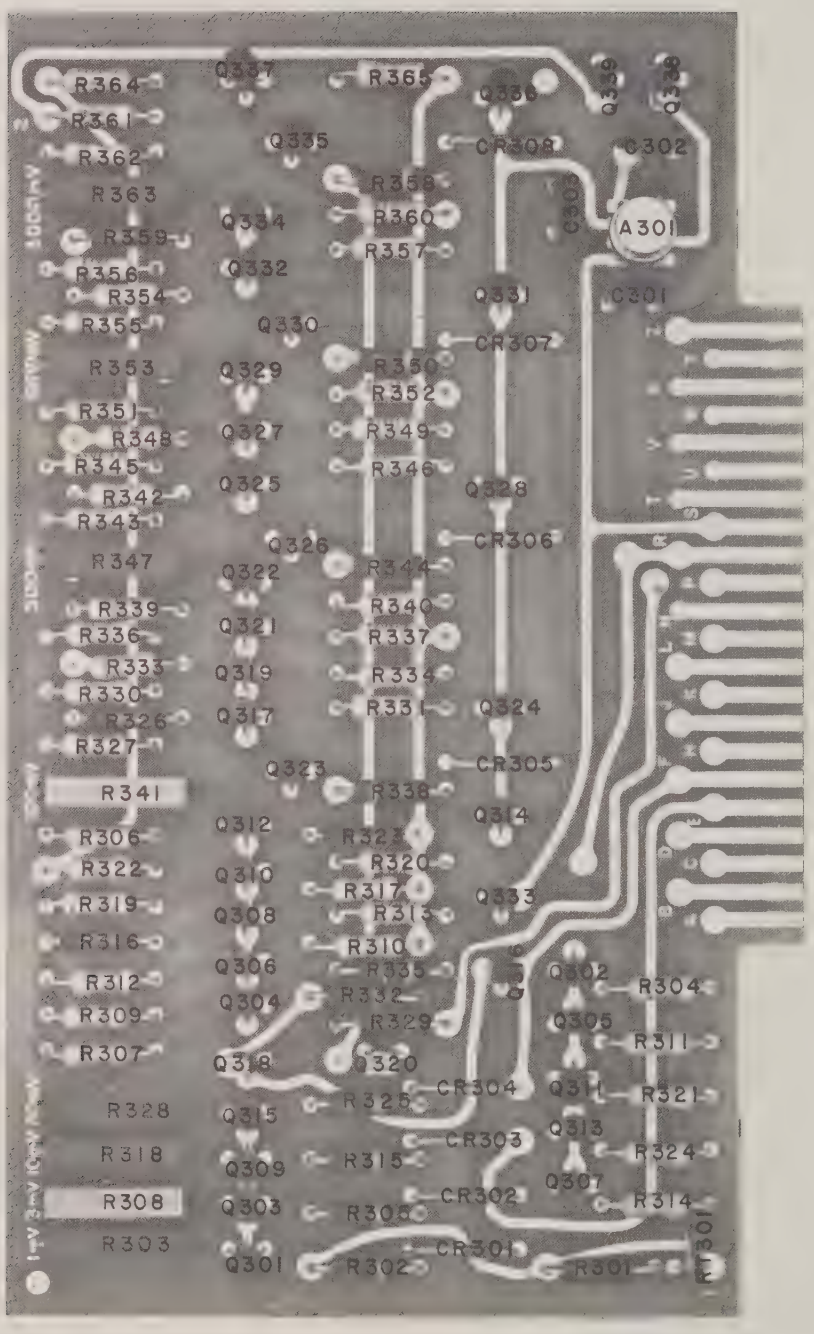
NOTES:

1. CAPACITANCE VALUES IN μF, UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS & 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
3. ☐ EXTERNAL MARKINGS.
4. ▽ COMMON
5. ——— SIGNAL PATH
6. TEST CONDITIONS:
   10mV RANGE / 10mV SIGNAL } 42, 92 SERIES
   10μW RANGE / 10μW SIGNAL } 42C ONLY
   ALL VOLTAGES NOMINAL. ALL READINGS IN VOLTS, UNLESS OTHERWISE SPECIFIED.
8. LAST NUMBERS USED:
   R245 C217 Q214 CR219 A201

COMPONENT NUMBERS
200 SERIES

BOONTON ELECTRONICS CORPORATION

MODEL 42B,BB,BD,C,CB,CD,
92B,BB,BD
Schematic, Chopper Driver
D830581K (Sheet 3 of 3)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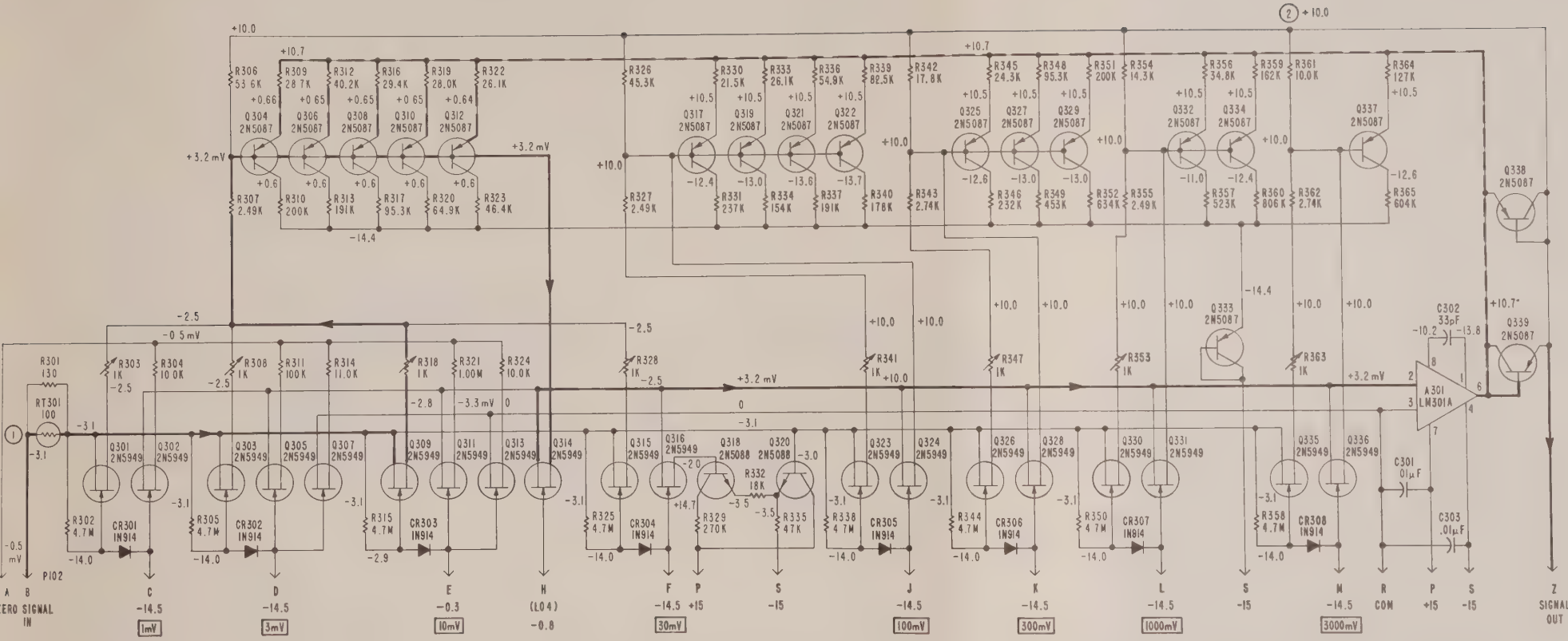
R302
R301
A301
C302
C301
R303

NOTES:
1. RESISTANCE VALUES IN OHMS.
2. SIGNAL PATH ———
3. FEEDBACK PATH — — —
4. ▭ EXTERNAL MARKINGS
5. LAST NUMBER USED:
R365 C303 Q339 CR308



BOONTON ELECTRONICS CORPORATION

MODEL 92 SERIES
Schematic, Shaping Amp.
D830456J (Sheet 3 of 3)

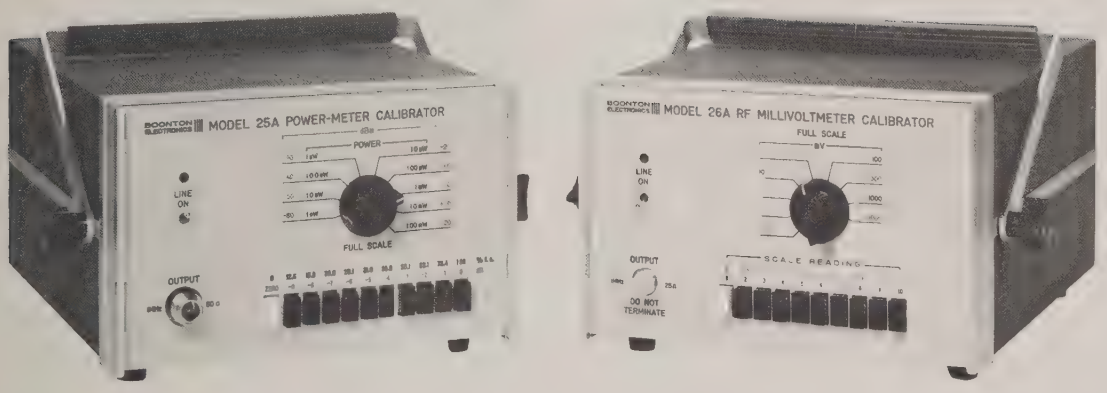
BOONTON

Model 25A
Power Meter Calibrator

Model 26A
RF Millivoltmeter Calibrator

Range Calibrators for use with all Boonton Power Meters and RF Millivoltmeters.

- ☐ Speeds calibration process
- ☐ Eliminates need for several other instruments
- ☐ Allows quick exchange of power sensors



GENERAL

These calibrators were designed for use with all Boonton Electronics Microwattmeters and RF Millivoltmeters. They provide the correct signal levels required to calibrate all instruments back to the earliest models. Full scale and incremental values for each range are provided. It is only necessary to connect the input of the meter under test to the calibrator output. The internal calibration controls of the microwattmeter or millivoltmeter can then be adjusted in accordance with instruction manual procedures (later models have this information tabulated under the top cover).

Apart from periodic checks, calibration is always required when exchanging power detectors or rf probes and for this purpose the calibrators are indispensable.

SPECIFICATIONS

	MODEL 25A POWER METER CALIBRATOR	MODEL 26A RF MILLIVOLTMETER CALIBRATOR
DYNAMIC RANGE	-69 to +20 dBm	60 µV to 3000 mV
FULL SCALE FUNCTIONS	-60, -50, -40 -30, -20, -10 0, +10, +20 dBm	0.3, 1, 3, 10, 30 100, 300, 1000, 3000 mV
DOWN SCALE INCREMENTS	0 to -9 dB 1 dB steps	20 -100% fs 10% fs steps
CALIBRATION UNCERTAINTY (at 25°C)	<±0.05 dB	<±0.5% RDG
HARMONIC DISTORTION	<0.15%	<0.15%
TEMPERATURE INFLUENCE (0 - 50°C)	+0.005 dB/°C	+0.01%/°C
OUTPUT FREQUENCY	1 MHz, xtal controlled	1 MHz, xtal controlled
OUTPUT IMPEDANCE	50 Ω	25 Ω
LINE	100, 120, 200, 240 VAC ±10% 50 to 400 Hz, 7 VA	100, 120, 200, 240 VAC ±10% 50 to 400 Hz, 7 VA

4/30/76

BOONTON
BOONTON ELECTRONICS CORP. ■ RTE. 287 AT SMITH ROAD, PARSIPPANY, N.J. 07054 ■ (201) 887-5110
Specifications are subject to change without notice

A D D E N D U M

IN-WARRANTY TRANSPORTATION COSTS

When equipment is returned to the factory under our 1 year warranty, transportation costs are covered as follows:

1. First 3 Months

   To Boonton Electronics - Paid by Boonton
   To Customer - Paid by Boonton

2. Subsequent 9 Months

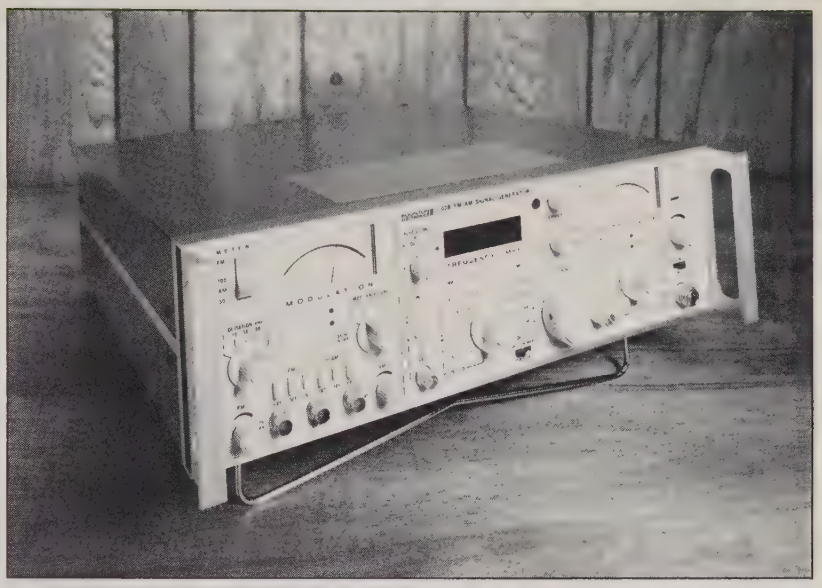
   To Boonton Electronics - Paid by Customer
   To Customer - Paid by Boonton

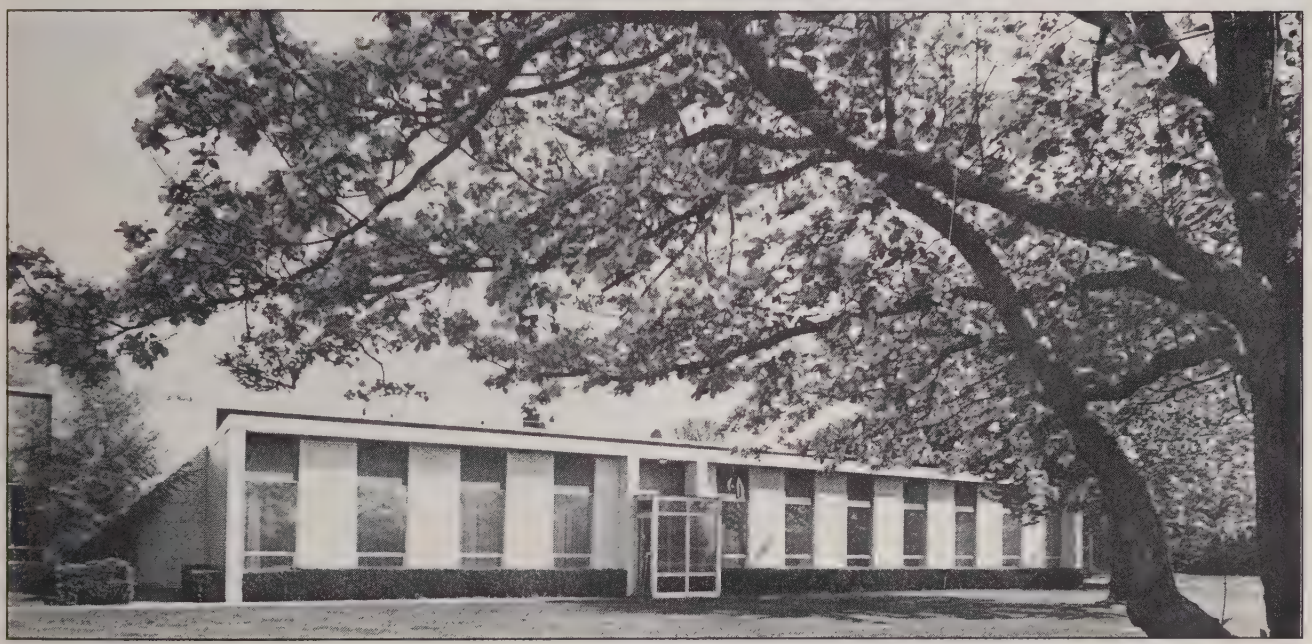
N O T E

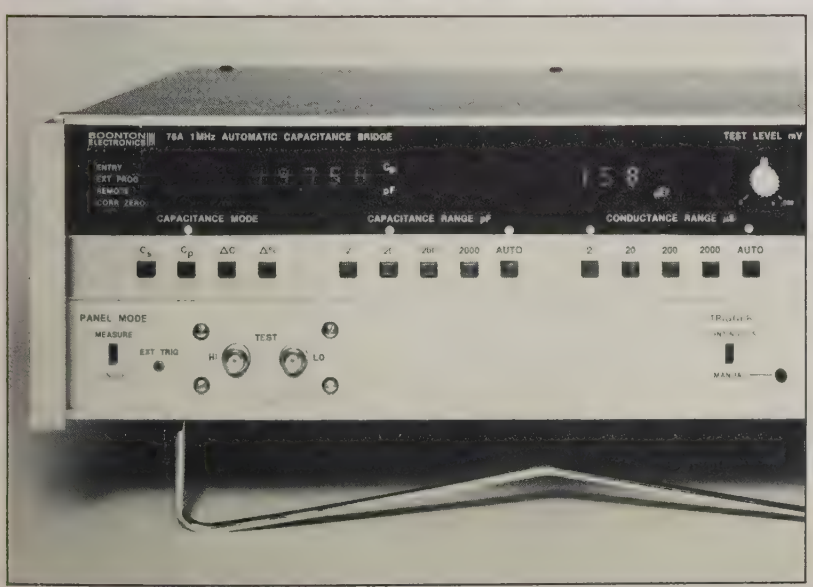
SHIPPING & PACKING INSTRUCTIONS. To avoid the delays and expense of shipping damage call our Repair Department in advance for instructions on the best ways to pack & ship the equipment.

July 9, 1974
cp

Condensed Catalog of Electronic Instruments







BOONTON
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RF Millivoltmeters
Model 92 Series

Available in four versions, these rf millivoltmeters offer the best choice for sensitive, wide-band, accurate rf voltage measurements.

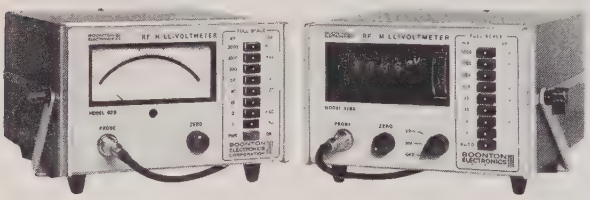
a) Model 92B, a programmable analog version, has a large mirrored-scale meter with linear 0-3 and 0-10 voltage ranges, a dBm scale (1 mW into 50Ω) and dc output.

b) Model 92BB is identical to Model 92B but with the addition of internal rechargable batteries.

c) Model 92BD, a programmable LED digital version, has 4 digit display, serial BCD data outputs, dc output, optional dBm display (0.01 dB resolution) and autoranging.

d) Model 92C, a low-cost analog version, saves by eliminating programming and dc output, by making the most sensitive range 3 mV fs, and by working to a more modest accuracy specification.

All models are supplied with rf probe, 50 Ω BNC adapter and probe tip. Many optional accessories extend their capability for other measurements.



SPECIFICATIONS

Analog Model 92B

Voltage Range: 200 μV to 3 V (300 V up to 700 MHz with divider). Useful indications down to 100 μV.
Frequency Range: 10 kHz to 1.2 GHz.
Basic Accuracy: ±(1% rdg + 1% fs).
Indicator: 4½" taut-band meter; scales 0-3, 0-10 and dBm.
Remote Control: All functions and ranges commanded by TTL inputs.
DC Output: 10 V fs.
Options: Many scale variations, other dB references, rear input.

Analog Battery Model 92BB

Specifications same as 92B. Sealed lead-acid rechargable 6 hour battery.

Digital Model 92BD

Voltage Range: 200 μV to 3 V (300 V up to 700 MHz with divider).
Frequency Range: 10 kHz to 1.2 GHz.
Basic Accuracy: ±(1% rdg + 1% fs).
Display: 4 digit LED, reads 1000 fs for "10" ranges and 3000 fs for "3" ranges. Small analog meter to right of display is scaled in dBm.
Data Outputs: BCD (serial) digits, binary coded range information. Overrange, underrange, encode complete.
Remote Control: All functions and ranges commanded with TTL inputs.
DC Output: 10 V fs.
Options: Autoranging, digital dBm readout (0.01 dB resolution), other dB references, rear input, BCD serial/parallel converter

Model 92C

Voltage Range: 500 μV to 3 V (300 V up to 700 MHz with divider).
Frequency Range: 10 kHz to 1.2 GHz.
Basic Accuracy: ±(1% rdg + 2% fs).
Indicator: 4½" taut-band meter; scales, 0-3, 0-10 and dBm.

FURNISHED ACCESSORIES

RF Probe with low noise cable and connector	91-12F
50 Ω BNC Adapter; 1 kHz to 600 MHz	91-8B*
Removable Probe Tip with grounding clip lead	91-13B

See rear page for optional accessories and calibrator.

* Available in 75 Ω version

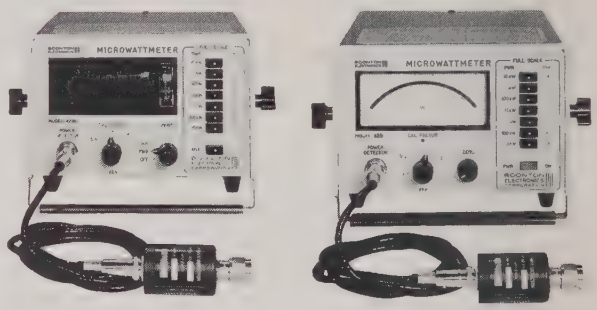
RF Microwattmeters
Model 42 Series

STANDARD VERSIONS

Virtually drift-free, these sensitive power meters cover a dynamic range of 70 dB from 1 nW to 10 mW (−60 to +10 dBm.) Overload tolerance is 0.3 W cw. Three 50 Ω power detectors offer a choice of frequency range. All start at a low 200 kHz covering up to as high as 18 GHz. A 75 Ω detector is available for CATV applications. The analog models (line or battery) are scaled in power and dBm. The digital model gives 3½ digit resolution for power and 4 digit resolution (0.01 dB) for the optional dBm display.

HIGHER POWER VERSIONS

Specifically designed to use the higher power detector Model 41-5E these power meters cover a power range of 10 dB higher than the standard models and provide low VSWR. The dynamic range of 70 dB covers power measurements from 10 nW to 100 mW (−50 to +20 dBm.) Overload tolerance is greater than 2 W cw. All features and options of the standard models apply.



SPECIFICATIONS (Standard Versions)

Digital Model 42BD

Power Range: 10 nW fs to 10 mW fs.
Frequency Range: 200 kHz to 18 GHz.
Accuracy: Overall, instrument and detector. ±(0.2 dB + 1 digit) to ±(0.8 dB + 1 digit) depending on power range and frequency.
Stability: <1 nanowatt/hour at 25°C
Temperature Effect: 0.007 dB/ °C typ.
Indicator: 3½ digit LED display for power, 4 digit for dBm option.
Data Outputs: BCD (serial) digits, binary coded range, overrange, underrange, encode complete, TTL.
Remote Control: Input range, encode hold and trigger, manual disable, dBm and autorange commanded by TTL inputs.
DC Output: 10 V fs proportional to power.
Major Options: Autoranging, dBm display, BCD serial/parallel converter.

Analog Model 42B

Power Range: 10 nW fs to 10 mW fs.
Frequency Range: 200 kHz to 18 GHz.
Accuracy: Overall instrument and detector. ±(0.2 dB + 0.5% fs) to ±(0.8 dB + 1.0% fs) depending on power range and frequency.
Stability: <1 nanowatt/hour at 25°C
Temperature Effect: 0.007 dB/°C typ.
Indicator: 4½ inch taut band meter calibrated power and dBm.
Remote Control: Input range and manual disable commanded by TTL inputs.
DC Output: 10 V fs proportional to power.
Major Options: Meter scale and dc output linear with dBm. Rear input.

Analog Battery Model 42BB

Specifications same as 42B. Sealed lead-acid rechargeable 6 hour battery.

SPECIFICATIONS (Higher Power Versions)

Models: 42C Analog, 42CB Analog—Battery, 42CD Digital.
Power Range: 100 nW fs to 100 mW fs.
VSWR: <1.07 at 200 kHz, <1.28 at 18 GHz.
Stability: drift <10 nW/hour at 25°C.

ALL OTHER SPECIFICATIONS ARE THE SAME AS THE STANDARD VERSIONS.

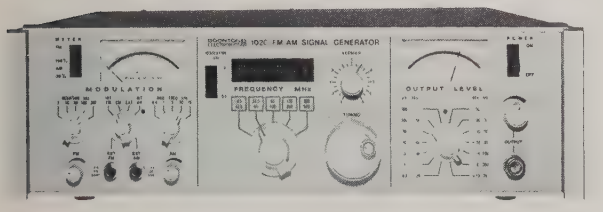
See rear page for power detectors and calibrator.

FM/AM Signal Generator – 450 kHz to 520 MHz
Model 102C

The 102C FM/AM Signal Generator is a well shielded, low noise source from 4.3 to 520 MHz that is both stable in frequency and accurate in level. Warmup time for most purposes is only 15 minutes and weight has been shrunk to 30 lbs. The front panel is designed to be easy to use and understand and all specifications are located on the top of the instrument for convenient reference. An adjustable "feel" main tuning drive brings smoothness and ease to narrow-band receiver setting.

Some of the main features are an excellent residual FMspecification, 100 Hz resolution on a 6 digit frequency display, individual metering of modulation and RF output, true peak monitoring of AM level and FM deviation, 0-300 kHz internal FM deviation on all bands and external FM deviations as wide as 2 MHz p-p even at the lowest carrier frequency.

Special options are available for NAV/COM applications.



SPECIFICATIONS

FREQUENCY
Ranges: .45-37.5, 32.5-65, 65-130, 130-260, 260-520 MHz
Accuracy: ±(100 Hz + 5 ppm).
Stability: Bands 2-5, <20 ppm/10 min. after 1 hour warmup
Band 1, <1.5 kHz/10 min. after 1 hour warmup
Residual FM: Bands 2-5, < 0.2 ppm peak (20 Hz to 15 kHz); band 1, < 15 Hz peak.
Display: Six digit LED; resolution 100 Hz, 1 kHz and 10 kHz.

RF OUTPUT
Power Level: −130 dBm to +13 dBm.
Attenuator: 13 steps, 10 dB/step, plus variable 13 dB.
Accuracy: ±2 dB max.
Leveling: ±0.5 dB.
Spurious Output: > 30 dB down. (−25 dB below 5 MHz)
Impedance: 50 Ω; VSWR < 1.5:1.

FREQUENCY MODULATION
Deviation: 0 to 300 kHz in five ranges.
Accuracy: ±10% fs.
Bandwidth: DC to 200 kHz.
Distortion: Bands 3, 4, 5: < 0.5% THD at 100 kHz peak dev.
Bands 1, 2: < 1% THD at 100 kHz peak dev.

AMPLITUDE MODULATION
Percent: 0 to 100.
Calibrated Ranges: 30%, 100% fs.
Bandwidth: DC to 20 kHz.
Distortion (at 1 kHz rate): < 1% THD at 30% AM;
< 2% THD at 70% AM (typically < 3% THD at 90% AM).

INTERNAL MODULATION
Frequencies: 400 Hz, 1, 3, 10, 19 kHz
Accuracy: ±3%
Distortion: 0.3%

MAJOR OPTIONS
Ext. clock input, special modulation frequencies, NAV/COM version, fused rf output, accessory frequency doubler. High accuracy counter reference.

FM/AM Signal Generator – 450 kHz to 520 MHz
Model 102D (Phase Locked)

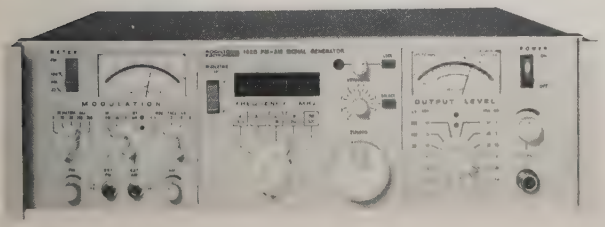
The output frequency of the Model 102D can be synchronized to a very stable internal reference oscillator by means of a built-in locking circuit. A unique feature is that the frequency counter is run by an identical but separate oscillator. This allows display of the true output frequency even when the vernier is used to tune between lock points. Full 100 Hz resolution is maintained.

The locking process is a simple matter. The generator is set to the desired frequency and the lock button depressed. Fine tuning is accomplished by the lock vernier control. Lock is indicated by a lamp adjacent to frequency display. If lock is lost (as when changing frequency) the lamp flashes. When this happens the unlock button is pressed, the frequency is reset as desired, and the lock button again pressed to re-establish lock.

The 102D output frequency also may be locked to an external 1 MHz reference for even higher stability, and the internal reference signal is available at a rear output connector for synchronizing two or more generators.

Frequency lock is maintained indefinitely once the generator is warmed up and operated under reasonably stable environmental conditions. This is the result of the inherently high frequency stability of the generator in the unlocked mode.

Little restriction of frequency modulation capability results from the locking feature. Deviations of up to 300 kHz at rates of 50 Hz to 200 kHz are possible without loss of lock or degradation of lock. The full FM bandwidth down to DC is available in the unlocked mode. This excellent FM performance is attributable to the narrow 5 Hz bandwidth of the phase lock loop which also ensures that noise specifications are the same for locked and unlocked modes of operation.



SPECIFICATIONS

FREQUENCY (locked, internal ref.)

Stability*: Bands 2-5, <0.2 ppm/hr after 1 hour warmup
<0.05 ppm/hr after 4 hour warmup
Band 1 <100 Hz/hr after 1 hour warmup
Temperature Influence: Bands 2-5, <2 ppm 15°C to 35°C
Band 1 <5 kHz 15°C to 35°C
Line Voltage Influence: Bands 2-5, <0.1 ppm for nominal ±10%
Band 1 <50 Hz for nominal ±10%
Accuracy (locked or unlocked): ±(resolution + 1 ppm), 15°C to 35°C when calibrated at 25°C every 3 months.

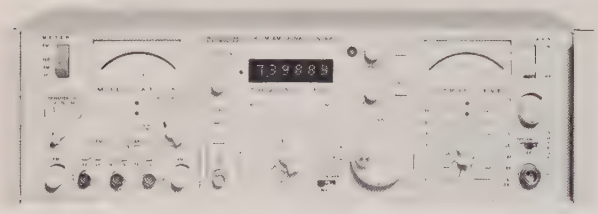
GENERAL
Internal Reference Oscillator:
Frequency: 1 MHz
Accuracy: ±1 ppm, 15°C to 35°C
Drift Rate: <0.05 ppm/hr after 4 hour warmup
<2 ppm/yr after 4 hour warmup
Output Level: 1 V rms, nominal
Source Resistance: 1000 Ω, nominal
External Reference Input:
Frequency: 1 MHz, nominal
Level: 0.2 to 5 V rms into 1000 Ω

FREQUENCY MODULATION
Bandwidth: 50 Hz to 200 kHz locked, DC to 200 kHz unlocked. (3 dB bandwidth referenced to 10 kHz.)

*At constant ambient temperature in the 15°C to 35°C range and constant line voltage.

ALL OTHER SPECIFICATIONS ARE THE SAME AS MODEL 102C.

FM/AM Signal Generators - 125 kHz to 175 MHz
Models 103A & 103B



The Boonton 103A/B Signal Generators cover important applications in design, production and maintenance of receivers and systems in the entertainment and communications fields.

They have these important advantages.

- High resolution and accuracy provided by the digital frequency display.
- Phase-lock stability (103B).
- Separately metered, high quality, versatile FM and AM modulation channels.
- Wide output range −130 dBm to +23 dBm (3 V).
- Five sweep ranges with digital readout of sweep center-frequency and the frequency of a variable marker.
- External count capability to the full accuracy and resolution of the frequency display.

FREQUENCY

The six-digit LED display has selectable resolutions down to 1 Hz below 16 MHz and 10 Hz above. The zero backlash, adjustable-friction controls give velvet smooth tuning to take full advantage of this resolution and unusually good unlocked stability minimizes the need to retune.

PHASE-LOCK (103B only)

To lock the 103B, the generator is set to the desired frequency and the LOCK button depressed. This locks the RF output frequency to an internal temperature-compensated reference crystal-oscillator. Fine tuning is accomplished by the LOCK VERNIER control. However, because the lock reference is separate from the display reference the full display resolution is available when the LOCK VERNIER is used to tune between lock points.

MODULATION

Five internal sinewave modulation frequencies, plus a ramp for sweep operation, are supplied as standard.

Maximum calibrated and metered FM deviation is 100 kHz from 8 to 32 MHz, and 300 kHz above 32 MHz. Bandwidth is dc to 200 kHz, except in the 103B when it is operated in the phase-lock mode, where the bandwidth is 50 Hz to 200 kHz. Total harmonic distortion is less than 0.15% for 75 kHz deviation in the FM broadcast band, and stereo separation is better than 43 dB. Deviation ranges are from 3 kHz to 300 kHz in a 3-10-30 sequence. Metering accuracy is 7% fs, true peak-responding.

Full-scale AM ranges of 30% and 100% are provided with an accuracy of 2% plus 3% of reading up to 80% AM. Bandwidth is dc to 10 kHz up to 1MHz, and dc to 20 kHz above 1 MHz. Total harmonic distortion is less than 1% at 30% AM for a 1 kHz rate. A rear-panel demodulated AM output is provided.

SWEEP CAPABILITY

When one of the five sweep ranges is selected, the vernier control adjusts sweep center-frequency and the main tuning control adjusts a marker whose frequency is read on the counter display.

Sweep width is adjusted using the FM control in conjunction with a calibrated range on the modulation meter. Sweep output is via the RF output connector, and it is monitored, leveled, and adjusted in the same way as the normal RF output of the generator.

The internal sweep ramp is at a 35 Hz rate.

RF AND SWEEP OUTPUT

The output level is switched in 13 steps of 10 dB from −120 dBm to +10 dBm. Settings between these steps and down to −130 dBm are made using the variable control and are read on the output meter.

The rf output can be switched off by a front panel slide switch. This same switch can also be used to obtain a special high level metered output to +23 dBm (3 V into 50 Ω).

OPTIONS

Rear rf output connector; special modulation frequencies; fused rf output; high-Z modulation inputs; external clock input; 75 μs pre-emphasis in FM channel; special sweep ranges; 75 Ω RF output; CB modulation meter markings; FM on band 6 (30 kHz maximum); and 5 Ω output impedance transformer.

SPECIFICATIONS

FREQUENCY

RF Ranges:

Band	*Range*
1	0.125 — 0.25 MHz
2	0.25 — 0.5 MHz
3	0.5 — 1 MHz
4	1 — 2 MHz
5	2 — 4 MHz
6	4 — 8 MHz
7	8 — 16 MHz
8	16 — 32 MHz
9	32 — 64 MHz
10	64 — 138 MHz
11	138 — 175 MHz

Accuracy: ± (resolution + 1 ppm), 15°C to 35°C after 1 hour
Resolution: Selectable: 1 Hz (Bands 1-7 only), 10 Hz, 100 Hz, 1 kHz
Stability: 10 ppm/10 min. after 2 hr., Bands 1-11. In phase-locked mode <0.05 ppm/hr. after 4 hrs., 0.2 ppm/hr. after 1 hr. (103B only)

FREQUENCY SWEEP

Ranges:

f_o	*Max. Sweep Width*
262 kHz	±30 kHz
455 kHz	±30 kHz
1.2 MHz	±100 kHz
10.7 MHz	±1 MHz
98 MHz	±10 MHz

Drive: *Internal:* 35 Hz ramp (adjustable internally)
External: 10 Hz to 1 kHz rates, use FM input

EXTERNAL COUNTER

Frequency Range: 5 Hz to 175 MHz
Sensitivity: >100 mV
Display and Resolution: Same as main frequency readout
Reference Accuracy: <±1 ppm, 15°C to 35°C

FREQUENCY MODULATION

Max. Deviation: Bands 9-11 (32-175 MHz), 300 kHz peak
Bands 7-8 (8-32 MHz), 100 kHz peak
Ranges: 3, 10, 30, 100, 300 kHz (red markings at 22.5 and 75 kHz)
Accuracy: ±7% fs
Bandwidth: Unlocked, DC to 200 kHz
Locked, 50 Hz to 200 kHz (103B only)

Distortion:

Band	*THD at 100 kHz Dev.*	*THD at 75 kHz Dev.*
7	2%	
8	1.0	
9	0.5	
10	0.25	0.15%
11	0.5	

Stereo Channel Separation: > 43 dB (50 Hz to 15 kHz rates) *(band 10)*

SPECTRAL PURITY

SSB Total Noise: 120 dB/Hz at 20 kHz offset.

AMPLITUDE MODULATION

Ranges: 30%, 100% fs
Accuracy: ±(2% + 3% of reading) to 80% AM at 1 kHz rate
Bandwidth: DC to 20 kHz (to 10 kHz bands 2 & 3, 5 kHz band 1)
Distortion: *(1 kHz rates)* At 30% AM, <1% THD all bands
At 80% AM, <2% THD bands 4-11
<3% THD bands 2 & 3
<5% THD band 1

INTERNAL MODULATION OSCILLATOR

Frequencies: *Sine:* 400 Hz, 1 kHz, 3 kHz, 10 kHz, and 19 kHz
Ramp: 35 Hz (internally adjustable)
Sinewave Distortion: <0.2% THD

RF AND SWEEP OUTPUT

Level (normal): −130 dBm to +13 dBm
Level (high): To +23 dBm (3V) all bands, Restricted AM
Attenuator: 13 steps of 10 dB/step + variable 13 dB calibrated on output meter.
Accuracy: ± (1 dB* + 0.1 dB/10 dB step) *1.5 dB, band 1
Leveling: ±0.5 dB
Impedance: 50 Ω, VSWR < 1.3 below 0 dBm
RF Interrupt: > 30 dB isolation (at 0 dB on output meter)

Automatic 1 MHz Capacitance Bridge
Model 76A

The Model 76A combines established precision bridge techniques with an automatic balancing system and internal computing facilities. It makes fully automatic, triggered or free running, 1 MHz parallel capacitance and conductance measurements with test levels of from 5 to 200 mV rms. Independent range selection or autoranging for both capacitance and loss is made using the convenient front-panel push-button controls. Enunciators show the range or mode in use.

The bridge will compute and display on command the equivalent series capacitance, series resistance, dissipation (tan δ), or Q of the test. In addition, any capacitance measurement can be displayed as a deviation in capacitance or a percentage deviation versus a previously entered and stored value.

The push button controls have a secondary function when the "entry" mode is selected. In this mode they may be used to program numbers which appear in the right hand display. These numbers may be entered into storage as a reference capacitance value for deviation measurements or entered to set a dc bias voltage on the optional internal supply.

A unique "corrected zero" feature of the 76A supplements the front panel coarse and fine C & G zero controls. In this mode the zero offsets of every combination of C & G range are automatically measured and stored for correction of subsequent readings.

Measurements may be made at the front panel test inputs or at the end of shielded test leads. When "remote test point" is selected a stored program is used to calculate and correct for each measurement made through the 30 inch test cables supplied.

Versatile remote control input and data output options are available, including the IEEE 488-1975 Interface Bus.

SPECIFICATIONS

Capacitance: 0-2000 pF in 4 ranges;
0-1.9999 pF, 0-19.999 pF, 0-199.99 pF, 0-1999.9 pF

Capacitance Accuracy:

$$\text{C error, (pF)} < \pm\left[\frac{\text{C(pF)}}{1000} + \frac{\text{g}(\mu\text{S})}{20000} + \frac{\text{C fs(pF)}}{20000} + 0.0005\left(\frac{1+10\text{D}}{1+\text{D}}\right)^2 + \frac{0.02}{\text{L}}\right]$$

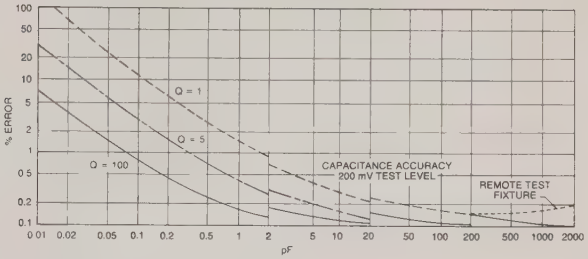
where L = test level in mV

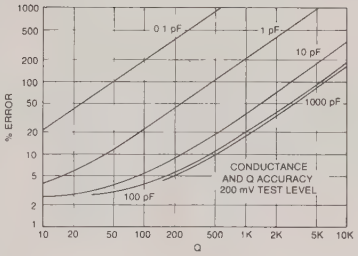
Conductance: 0-2000 μS in 4 ranges;
0-1.999 μS, 0-19.99 μS, 0-199.9 μS, 0-1999 μS

Conductance Accuracy:

$$\text{g error, } (\mu\text{S}) < \pm\left[\frac{\text{g}(\mu\text{S})}{50} + \frac{\text{C(pF)}}{1000} + \frac{\text{g fs}(\mu\text{S})}{2000} + 0.001\left(\frac{1+10\text{Q}}{1+\text{Q}}\right) + \frac{0.2}{\text{L}}\right]$$

where L = test level in mV





NOTES

1. Q = 5 line above 20 pF is closely coincident with Q = 100 line.
2. Q = 1 line above 200 pF is closely coincident with Q = 100 line.

Test Signal: 1 MHz, 5-200mV, variable
Test Time: <100 ms, C >2 pF and G >2 μS.
<500 ms, C <2 pF or G <2 μS.
Display: Dual digital readout, decimal points, units, modes, active ranges.
Display Modes: C_p, C_s, ΔC, Δ%, G, R_p, R_s, D (tan δ), Q.
Autoranging: Standard.
Trigger Modes: Continuous (1 per sec), manual, external.
DC Bias: External input, ±200 V, 30 mA fused.
Supplied Accessories: Universal test fixture with 30" input cables.
Options:

-01 IEEE 488-1975 Interface Bus.*
-02 Parallel BCD Data Outputs, TTL isolated*
-03 Programmable DC Bias
Range: 0 to 200 volts, unipolar, 5 mA max.
Resolution: 5 m V for bias to 20 volts
50 mV for bias from 20 to 200 volts
Programming: Entered numerically from panel or externally programmed.
Accuracy: .05% of setting + resolution

**May not be installed at the same time.*

Capacitance Classification Systems
Model 170 Series

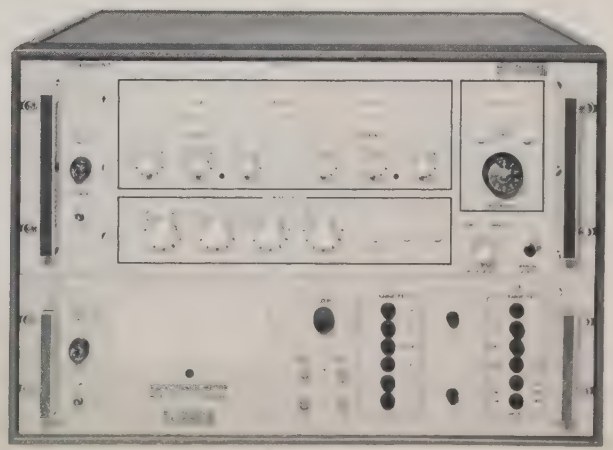
The 170 Series is designed to control component handling equipment for high-speed testing of capacitors.

The Series is based on two control units: one for high-accept-low limit testing, and one for up to eight accept zones plus high and low reject limits for multi-category sorting. Either control unit can be combined with a 1 kHz or 1 MHz capacitance measurement module to form a complete system. If the 1 kHz module is chosen, additional sorting can be done according to a pre-set dissipation limit.

The 1 kHz module measures capacitance from 10 pF to 10 μF and DF from 0.001 to 0.1. The 1 MHz module measures capacitance from 0.1 pF to 1000 pF. Accuracy is typically 0.25% of reading. Each has an analog meter for measurement readout.

Nominal capacitance values, tolerances or categories in ±%, and maximum 1 kHz dissipation factor are programmed on the front panel of either control unit. Decisions are displayed by panel lights and mercury wetted relay closures provide electrical outputs for connection to a mechanical component handler. Limit decisions are made within 70 ms, multi-category decisions within 70 to 150 ms.

The 170 Series can be operated in either a continuous or a triggered mode.



True RMS Voltmeters
Model 93 Series

The Boonton 93A and 93AD voltmeters are true rms responding instruments that use backward diodes as balanced, low-level, square-law detectors. An all solid-state chopper amplifier and unique operational square-root circuitry convert the squared function to a high-level dc proportional to rms. This dc voltage is available at rear terminals for rms converter applications, and is displayed on an analog meter in the case of the 93A or on a 3½ digit LED display for the 93AD. The 93A and 93AD both cover twelve ac voltage ranges from 1 mV to 300 V full-scale. The 1 mV full-scale range provides unmatched sensitivity to measure the low rms level of noise and of low duty cycle pulse trains. Both rms voltmeters feature a full 10 Hz to 20 MHz frequency range usable down to the lowest voltage range. A three dB bandwidth of 30 MHz assures accurate rms measurements of complex voltages with significant high frequency energy components, such as narrow pulses and wideband noise. The 93A meter is calibrated with dBm as well as voltage scales. The 93AD has, as standard, an edge-mounted dBm analog meter in addition to the digital display; an optional dB display provides readings directly in dB with 0.01 dB resolution.

SPECIFICATIONS

Analog Model 93A

Voltage Range: 1 mV to 300 V fs, in 12 ranges.
dBm Range: −68 dBm to +52 dBm (600 Ω ref.).
Selectable Bandwidth: 10 Hz to 20 MHz or
10 Hz to 100 kHz
Basic Accuracy: ±1% fs or ±2% rdg, whichever is better.
Indicator: 4½" taut-band meter; scales 0-3, 0-10 and dBm.
Response Time: Fast; 1 sec. Slow; 4 sec.
Crest Factor: 6 at full scale; 18 at down scale.
Input: *Impedance:* 2 MΩ, < 25 pF.
Equivalent noise: < 35 μV.
DC Output: +10 V for fs.
Remote Control: All functions and ranges commanded with TTL input.
Options:
Rear signal input.
50 Ω dBm reference.
75 Ω dBm reference.
Accessory: 93-1A High-Z probe; 10 MΩ,< 11.5 pF, attenuation 10x.

Digital Model 93AD

Voltage Range: 1 mV to 300 V rms fs, in 12 ranges.
dB Range: 120 dB; resolution, 0.01 dB (optional).
Selectable Bandwidth: 10 Hz to 20 MHz or
10 Hz to 100 kHz
Basic Accuracy: ±(1% rdg + 1 count) for voltage.
±0.3 dB for dB option.
Display: 3½ digit LED display (4 digits for dBm). Decimal point, units (V, mV, dB), under- and over-range, polarity (dBm only) also indicated. Analog edgemeter, scaled over 12 dB range.
Response Time: Fast; 1 sec. Slow; 4 sec.
Crest Factor: 6 at full scale; 18 at down scale.
Input: *Impedance:* 1 MΩ, < 25 pF.
Equivalent noise: < 35 μV.
Outputs: BCD (serial) digits, binary range and mode information.
DC Output: 10 V for fs.
Remote Control: All functions and ranges commanded with TTL input.
Options:
Autoranging.
Rear signal-input.
50 Ω dBm display.
75 Ω dBm display.
600 Ω dBm display.
BCD serial/parallel converter
Accessory: 93-1A High-Z probe; 10 MΩ, < 11.5 pF, attenuation 10x.

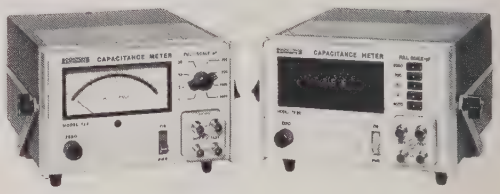
Capacitance Meters—1 MHz
Model 72 Series

The Model 72 Series of solid-state capacitance meters provide rapid, accurate, three-terminal measurements of capacitance, particularly of semiconductor devices because of the low test level employed (15 mV rms) and the provision for application of dc bias to the test.

The phase-sensitive detection system allows the capacitance of even low Q devices (as low as Q = 1) to be measured with little reduction in accuracy. Range switching is accomplished by a combination of logic-controlled reed relays and diodes. Range selection is by front panel switch or remote TTL inputs.

Both models provide a highly linear, high-speed, dc analog voltage output corresponding to the meter or display indication. In addition, the 72BD has BCD outputs, TTL compatible. Autoranging of this model is standard.

Adapters are supplied for coaxial-cable connection to a remote test fixture, and for direct attachment of wire-lead components.



SPECIFICATIONS

Digital Model 72BD

Capacitance Ranges: 2.000, 20.00, 200.0, 2000 pF fs.
Basic Accuracy: ±(0.25% rdg +0.2% fs).
Display: LED-type, 4 digits.
Data Outputs: Serial by digit, TTL.
Commands: Range (4 lines); manual disable; autorange enable; encode hold, encode trigger; TTL.
DC Output: 2 V for fs all ranges; linearity ±(0.1% rdg +0.005% fs). Response time < 2 ms.
Test Signal: 1 MHz, 15 mV rms.
DC Bias: External ±600 V max.
Autoranging: Standard, 100 ms per range.
Options: 100 mV test level, BCD serial/parallel converter.

Analog Model 72B

Capacitance Ranges: 1, 3, 10, 30, 100, 300, 1000, 3000 pF fs.
Basic Accuracy: ±(0.5% rdg + 0.5% fs).
Resolution: 0.5% fs for each range.
Meter: 4½ inch taut-band type.
Commands: Range (8 lines); manual disable; TTL.
DC Output: 1 V for fs (1 series ranges); 3 V for fs (3 series ranges); linearity, ±(0.1% rdg +0.01% fs); response time <1 ms.
Test Signal: 1 MHz, 15 mV rms.
DC Bias: External ±600 V max.
Option: 100 mV test level.

Capacitance/Inductance Meter—1 MHz
Model 71A

Quick, convenient, direct reading, 3-terminal measurements of capacitance and 2-terminal measurements of inductance at 1 MHz. Operates with low test signal level, permitting semiconductor tests. Provision for dc bias. Linear dc output proportional to capacitance or inductance reading for display on dvm, x-y plotter, etc.

SPECIFICATIONS

Capacitance: 1 pF to 1000 pF fs in 7 ranges; basic accuracy, ± (0.5% rdg. + 0.5% fs); resolution, 0.25% fs, Q > 3.
Inductance: 1 μH to 1 mH fs in 7 ranges; basic accuracy, ±0.5% rdg ±0.5% fs.
Test Signal: 1 MHz; 15 mV rms for C, < 1 mV for L.
DC Bias: External ±200 V; (±600 V to special order).
DC Analog Output: 0 to 100 mV or 300 mV fs depending on range numerics; response time < 10 ms; (1 ms to special order).

RF Admittance Bridges — 1 MHz to 100 MHz

Model 33 Series

These bridges measure two-terminal parallel capacitance and conductance at 1, 5, 10, 20, 30, 50, and 100 MHz. Other frequencies between 1 and 100 MHz can be provided to special order. Good resolution of low conductance values makes loss measurements possible on many high Q diodes, varactors, and capacitors. The bridge balances accurately with the low test levels required for measurements on most solid state devices. Internal and external dc bias is standard.

SPECIFICATIONS

Model 33A/1

Capacitance: 0-150 pF (30 pF at 100 MHz); resolution, 0.02 pF; basic accuracy, ±0.3%.
Conductance: 0-25 mS; resolution, 0.5 μS or better; basic accuracy, ±2%.

Model 33B/1

Capacitance: 0-150 pF (30 pF at 100 MHz); resolution, 0.02 pF; basic accuracy, ±0.3%.
Conductance: 0-5 mS; resolution, 0.1 μS or better; basic accuracy, ±2%.

Model 33C/1

Capacitance: 0-15 pF; resolution, 0.002 pF; basic accuracy, ±1%.
Conductance: 0-25 mS; resolution, 0.5 μS or better; basic accuracy, ±2%.

Model 33D/1

Capacitance: 0-15 pF; resolution, 0.002 pF; basic accuracy, ±1%.
Conductance: 0-5 mS; resolution, 0.1 μS or better; basic accuracy, ±2%.

Capacitance Range Extensions: Accessories available for measuring higher values of capacitance at frequencies up to 30 MHz for Model 33A/1 and to 20 MHz for Model 33B/1.

Capacitance Bridge — 5 kHz to 500 kHz

Model 75C

The Model 75C is a precise, high resolution bridge which makes measurements of capacitance, conductance, and parallel resistance from 5 kHz to 500 kHz.

Three-terminal remote measurements may be made via shielded cables without incurring errors resulting from stray capacitance from either side of the test to ground.

A special version, Model 75C-S23,additionally allows the application of externally supplied dc bias up to ±400 V with fusing at 10 mA. It also provides for connection of external ac or dc null detectors to increase balance sensitivity.

SPECIFICATIONS

Capacitance: 0 to 1000 pF; basic accuracy, ±0.25%; resolution, 0.0002 pF max.
Conductance: 0 to 1000 μS; basic accuracy, ±10%; resolution, 0.001 μS max.
Test Signal: Internally supplied; continuously adjustable in frequency from 5 kHz to 500 kHz; level adjustable from 1 mV to 3 V rms.
DC Bias:
Model 75C: Internal only; −5 to +110 V, adjustable.
Model 75C-S23: Internal; −5 V to +110 V, adjustable. External; to ±400 V.

Capacitance Bridge — 1 MHz

Model 75D

This bridge provides 3-terminal measurements of capacitance and conductance allowing remote connection without errors due to stray capacitance to ground. An adapter for 2-terminal grounded measurements is available. Inductance is read by conversion from equivalent capacitance measurement.

The main capacitance dial consists of a "counter" dial that works in conjunction with a 40:1 vernier dial. This arrangement provides both ease of scanning and great accuracy of fine adjustment. Thus each range, including the lowest 0.1 pF fs range, is spread over 5000 divisions.

SPECIFICATIONS

Capacitance: 0 to 1000 pF; basic accuracy, ±0.25%; resolution, 0.00005 pF max.
Conductance: 0 to 1000 μS; basic accuracy ±5%; resolution, 0.01 μS max.
Inductance: 25 μH to 25 mH; basic accuracy, ±0.25%.
Test Signal: 1 MHz; level adjustable from 1 mV to 250 mV.
Internal DC Bias: HI to LO; −6 to +150 V.
Dual external DC Bias: HI to GND and/or LO to GND; differential, ±400 V max.

Capacitance Limit Bridge — 1 MHz

Model 77B

Performs automatic, high-speed dual or single limit tests, or conventional manual measurements of capacitance or inductance. In automatic mode, test is insensitive to specimen loss. "High", "Low", or "Go" test decisions are indicated by front panel lamps as well as by continuity closures for actuation of material handling equipment. 3-terminal arrangement permits remote measurements at the end of coaxial cables without incurring error due to cable capacitance to ground. Nominal capacitance values are set by the main capacitance balance dial in conjunction with its multiplier switch. A multi-turn control and range switch are used to program the desired tolerance. Operates with low test level. Built-in dc bias supply; provision for external bias.

SPECIFICATIONS

Capacitance: Automatic,0 to 1000 pF with 0.001 pF resolution max.; Manual, 0.0001 pF resolution max.; basic accuracy, ±0.25%.
Inductance: Manual or automatic, 25 μH to 25 mH; basic accuracy, ±0.25%.
Tolerance Limits: ±0.0005 pF to ±200 pF; basic accuracy, ±0.25% of limit setting.
Test Time: Approx. 50 ms.
Conductance: (Manual only) 0 to 1000 μS; basic accuracy, ±5%; resolution, 0.01 μS max.
Test Signal: 1 MHz, 250 mV to 15 mV rms for automatic mode, to 1 mV rms for manual.
Decision Output: Green, red, and amber panel lamps; continuity contacts.
DC Bias: Internal, −6V to +150 V; external, to ±400 V.

Inductance Bridges

Model 63 Series

These unique bridges provide direct-reading measurements of series inductance down to unusually low values with fractional percentage accuracy over broad frequency ranges. Series resistance is also directly measured. Each bridge is complete with built-in oscillator and detector. Test current does not change during balance.

SPECIFICATIONS

Model 63H

Inductance: 0.2 nH to 110 mH; basic accuracy ±0.25%.
Series Resistance: 0.2 mΩ to 11 kΩ; basic accuracy ±3%.
Test Signal: Frequency, 5 to 500 kHz; level, 3 V rms max.

Model 63L

Inductance: 20 nH to 11 H; basic accuracy ±0.25%.
Series Resistance: 10 mΩ to 110 kΩ; basic accuracy ±3%.
Test Signal: Frequency, 0.4 to 40 kHz; level, 5.5 V rms max.

Model 63M

Inductance: 2 nH to 1.1 H; basic accuracy ±0.25%.
Series Resistance: 2 mΩ to 110 kΩ; basic accuracy, ±3%.
Test Signal: Frequency, 1 to 100 kHz; level, 5.5 V rms max.

Inductance Meters — 1 MHz

Model 62 Series

The Model 62 Series inductance meters provide fast, accurate, two-terminal, series inductance measurements at 1 MHz with low test current. Both analog and digital models are programmable and have a linear, high-speed, dc analog output. Remote test fixture available.

SPECIFICATIONS

Digital Model 62AD

Inductance Ranges: 2.000, 20.00, 200.0, 2000 μH fs
Basic Accuracy: ± (0.5% rdg + 0.2% fs)
Display: LED-type, 4 digits
Data Outputs: Serial by digit, TTL
Commands: Range (4 lines); manual disable; autorange enable; encode hold; encode trigger; TTL
DC Output: 2 V for fs all ranges
Test Signal: 1 MHz; level, 160 μA max.
Autoranging: Standard, 100 ms per range change

Analog Model 62A

Inductance Ranges: 1, 3, 10, 30, 100, 300, 1000, 3000 μH fs
Basic Accuracy: ±(0.5% rdg + 0.5% fs)
Resolution: 0.5% fs all ranges
Meter: 4½ inch taut-band type
Commands: Range (8 lines); manual disable; TTL
DC Output: 1 V fs (1 series ranges); 3 V fs (3 series ranges)
Test Signal: 1 MHz; level, 160 μA max.

RF Millivoltmeter Optional Accessories

Low Frequency Probe, 1 kHz to 250 MHz	91-4C
Unterminated BNC Adapter	91-6C
100:1 Voltage Divider, 50 kHz to 700 MHz	91-7C
Type N Tee Adapter, 1 kHz to 1.2 GHz	91-14A*
Type N 50 Ω termination (use with 91-14A)	91-15A*
Unterminated Type N Adapter	91-16A
Storage container for accessories	91-18A
Accessory Kit: Model 91-6C Unterminated BNC Adapter Model 91-7C 100:1 Voltage Divider Model 91-14A 50 Ω Tee Adapter Model 91-15A 50 Ω Termination Model 91-18A Storage Case	91-24A*
Rack-Mounting Kit (mounts left or right)	92-1A
Dual Rack-Mounting Kit	92-1B
Portable Field Case	92-9A

*Available in 75 Ω versions (calibrated to 300 MHz)

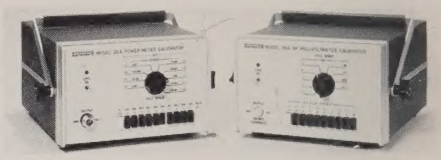
RF Microwattmeter Power Detectors

200 kHz – 7 GHz, 50 Ω, −60 to +10 dBm.	41-4A
200 kHz – 12.4 GHz, 50 Ω, −60 to +10 dBm.	41-4B
200 kHz – 1 GHz, 75 Ω, −60 to +10 dBm.	41-4C
200 kHz – 18 GHz, 50 Ω, −60 to +10 dBm.	41-4E
200 kHz – 18 GHz, 50 Ω, −50 to +20 dBm.	41-5E*

*For use with 42C series only

Calibrators
Models 25A and 26A

Provide full scale and incremental signal levels required for calibration of all Boonton Power Meters and RF Millivoltmeters.



	MODEL 25A POWER METER CALIBRATOR	MODEL 26A RF MILLIVOLTMETER CALIBRATOR
Dynamic Range:	−69 to +20 dBm	60 μV to 3000 mV
Full Scale Functions:	−60, −50, −40 −30, −20, −10 0, +10, +20 dBm	0.3, 1, 3, 10, 30 100, 300, 1000, 3000 mV
Down Scale Increments:	0 to −9 dB 1 dB steps	20 −100% fs 10% fs steps
Calibration Uncertainty: (at 25°C)	<±0.05 dB	<±0.5% RDG
Harmonic Distortion:	<0.15%	<0.15%
Temperature Influence: (0 – 50°C)	+0.005 dB/°C	+0.01%/°C
Output Frequency:	1 MHz, xtal controlled	1 MHz, xtal controlled
Output Impedance:	50 Ω	25 Ω
Line:	100, 120, 200, 240 VAC ±10% 50 to 400 Hz, 7 VA	100, 120, 200, 240 VAC ±10% 50 to 400 Hz, 7 VA

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We will repair or, at our option, replace at no charge any of our products which are found to be defective under the terms of this warranty. Except for such repair or replacement, we will not be liable for any incidental damages or for any consequential damages, as those terms are defined in Section 2-715 of the Uniform Commercial Code, in connection with products covered by this warranty.

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